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GEOLOGY AND PALEONTOLOGY OF THE SOUTHEAST ARCTIC PLATFORM AND SOUTHERN BAFFIN ISLAND, NUNAVUT

A.D. McCracken and T.E. Bolton (editors)

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with contributions by

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Cover Illustration
Plectoceras lowi Foerste, a coiled nautiloid preserved with a sediment-filled living chamber. Hypotype, GSC 113694, from the Frobisher Bay Formation on Hone River (GSC loc. O-104197). Maximum diameter is 240 mm (lens cap is 50 mm). See Plate 34, figures 9, 10 (GSC photo no. 4698-1).

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A BRIEF HISTORY OF GEOLOGICAL EXPLORATION ON THE FOXE LOWLAND AND ADJACENT TERRAINS OF SOUTHERN BAFFIN ISLAND, NUNAVUT

A.D. McCracken[1]

A brief history of geological exploration on the Foxe Lowland and adjacent terrains of southern Baffin Island, Nunavut; ***in*** *Geology and paleontology of the southeast Arctic Platform and southern Baffin Island, Nunavut; Geological Survey of Canada, Bulletin 557, p. 1–12.*

Abstract

Geological study of southern Baffin Island has had a long history and continues to the present. The discovery of what was thought to be gold in rock collected during the 1576 voyage of M. Frobisher prompted mining voyages back to Frobisher Bay in 1577 and 1578. The next expedition of geological significance was that of C.F. Hall in 1861. Hall discovered and named Silliman's Fossil Mount and returned with several fossil collections. Other explorers in the late 19th century who made geological observations include F. Boas, E.J. Peck, R.W. Porter, and, from the Geological Survey of Canada (GSC), R. Bell.

Between 1900 and 1930 there were numerous expeditions into the Foxe Lowland. These included those of A.P. Low, L.T. Burwash, J.D. Soper, L.J. Weeks, and M.H. Haycock for the Canadian Government, and B.A. Hantzsch (Germany), and G.P. Putnam and S.K. Roy (U.S.A). In the 1940s, another visit was made to Silliman's Fossil Mount, this time by American A.K. Miller. Renewed GSC interest began with mapping in 1949 led by Y.O. Fortier. This work continued through to R.G. Blackadar's Operation Amadjuak in 1965, which completed the reconnaissance mapping of the geology of southern Baffin Island.

Recent GSC parties have concentrated on the Ordovician (G. MacAuley, B.V. Sanford, and others) in the late 1980s, and the Precambrian in 1990s (D. Scott and others). A return to the amateur-led expeditions in the tradition of Hall and Putnam was S. Bart's 1996 American Expedition. Geological interest in the Baffin region continues since the creation of Nunavut in 1999.

Résumé

Les études géologiques menées dans le sud de l'île de Baffin ne datent pas d'hier et elles se poursuivent encore de nos jours. Après la fausse découverte d'or dans une roche rapportée par M. Frobisher lors de son voyage de 1576, on a organisé des expéditions à caractère minier en 1577 et 1578. L'expédition suivante d'importance pour la géologie est celle de C.F. Hall en 1861. Il a recueilli plusieurs collections de fossiles et a découvert et nommé le mont Silliman's Fossil. F. Boas, E.J. Peck, R.W. Porter, et R. Bell de la Commission géologique du Canada (CGC) sont d'autres explorateurs de la fin du 19^{e} siècle qui ont fait des observations géologiques dans cette région.

Entre 1900 et 1930, il y a eu plusieurs expéditions dans les basses terres de Foxe. On peut mentionner celles de A.P. Low, L.T. Burwash, J.D. Soper, L.J. Weeks et M.H. Haycock (pour le gouvernement du Canada), B.A. Hantzsch (Allemagne), et G.P. Putnam et S.K. Roy (É.-U.). Pendant les années 1940, l'américain A.K. Miller s'est rendu à son tour au mont Silliman's Fossil. En 1949, la CGC s'intéresse de nouveau à la région en entreprenant un projet de cartographie dirigé par Y.-O. Fortier. Ces travaux se poursuivent jusqu'à l'Opération Amadjuak de R.G. Blackadar (1965), qui a permis de compléter la cartographie géologique de reconnaissance de la partie sud de l'île de Baffin.

Les équipes récentes de la CGC ont axé leurs travaux sur l'Ordovicien (G. MacAuley, B.V. Sanford, et al.) à la fin des années 1980, et sur le Précambrien pendant les années 1990 (D. Scott et al.). L'excursion américaine de S. Bart en 1996 est un exemple d'expédition dirigée par des amateurs dans la tradition de celles menées par Hall et Putnam. L'intérêt géologique suscité par la région de l'île de Baffin s'est maintenu jusqu'à la création du Nunavut en 1999.

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INTRODUCTION

This volume reports on the geological and paleontological results of work in the Foxe Lowland of southern Baffin Island by the Geological Survey of Canada during the summers of 1988 and 1989. The Foxe Lowland is an outlier of Ordovician strata bounded by Precambrian rocks, and as such preserves valuable evidence on the Foxe and related sedimentary basins.

Contributors Sanford and Grant draw a detailed framework based on their surface and subsurface, and onshore and offshore studies in the Arctic and Hudson platforms. Bolton completed his tome on subarctic and Arctic Ordovician megafossils shortly before he passed away in November of 1997. Other contributions by McCracken (conodonts and other phosphatic microfossils), Copeland (ostracodes), Riva (graptolites), and Asselin, Achab, and Soufiane (chitinozoans) complete the volume. These are the latest, but not the last nor the first reports on this region of northern Canada.

16th century

The history of modern geological exploration in the Foxe Lowland began with the three Sir Martin Frobisher voyages into Frobisher Bay (Hogarth et al., 1994). The purpose of the first expedition, in 1576, was to search for a Northwest Passage. It comprised three small ships and thirty-five crew. The highlights of this voyage are few and ultimately not memorable: the strait was not an open seaway to the west; the first encounters between Europeans and natives were not peaceful, with kidnapping carried out by both sides; and the discovery of what was thought to be gold turned out not to be, even though it sparked the two following expeditions. As it happened, a small piece of a black, coal-like rock was brought back to England as a curiosity, and on later inspection was determined to contain what was thought gold. Gold fever thus financed the second and third voyages; on the second in 1577, the explorers stayed about five weeks, and then returned to England with about 200 tonnes of "ore". The third voyage, in 1578, was a major undertaking, comprising fifteen ships and the parts of a prefabricated house so that 100 miners could work over winter. Loss of the ship carrying parts for this house forestalled this plan. Instead, a small house and two assay furnaces were set up on Kodlunarn Island in Frobisher Bay, and more than 1,000 tonnes of "ore" were brought back (Roy, 1941; Cooke and Holland, 1978). As it is commonly known, there were no significant amounts of precious metals; it has been suggested that the glint of gold in the "ore" was the bronzy luster of mica contained in amphibolite (Roy, 1937, 1941). Hogarth and Loop (1986) suggested that the high Au–Ag estimates from Elizabethan assays were not a deliberate fraud nor because of primitive methodology, but were due to an enriched additive in the tests. Hogarth later traced the ultramafic ore to its storage in England, and by using mineralogical and chemical (including K–Ar geochronology) analyses, also determined that some of the ore had been shipwrecked in 1578 on southwest Ireland (Hogarth and Roddick, 1988, 1989; Hogarth and Jones, 1994).

19th century

The reader may note a three-century gap in this chronology of the Lowland area, but this doesn't mean that exploration elsewhere in the north ceased during this period. After Frobisher's voyages, numerous expeditions travelled through Hudson and Davis straits, either to explore, or establish whaling and trading posts. Efforts were made to survey the region in detail, helped in large part by the some thirty rescue parties for the ill-fated Franklin expedition. In more recent times, voyages had scientific, missionary, police and other government functions. Thus, the coastal regions of Baffin Island especially were known by both native population and foreigners. Expeditions to the interior were not as common, as shown on the Millward (1930) map of exploration routes (Fig. 1). Some explorers travelled over the Foxe Lowland, but not all for the purpose of studying the geology.

After Frobisher's mining attempts, no geological investigation occurred in the Lowland area until 1861, when Captain Charles F. Hall led an expedition in search of evidence about Sir John Franklin's missing party. Miller et al. (1954, p. 7) called Hall an American Naval Officer, but his title of Captain was strictly a courtesy. In reality he was an adventurer, who quit his small publishing business in Cincinnati in 1859 to organize an expedition to the Arctic. Berton (1988) described him as a former blacksmith and engraver, a high school dropout, who had no scientific background, no knowledge of navigation, and no training in any related skills. He was however, an "armchair explorer and romantic dreamer" (Berton, 1988, p. 346) who was obsessed with the Arctic. Hall found fossils at several localities, one lot of which was from drift materials on the north and east shores of Frobisher Bay and nearby areas. These were given to Amherst College, and described by Emerson (1879) and restudied later by Bassler (1911) and Schuchert (1914). One of these collections was in "flinty bituminous limestones" (Emerson, 1879, p. 575), or black limestone and limey shale containing graptolites and trilobites, which was similar to the Collingwood Formation of Ontario (Schuchert, 1914). At one locality, either on Blunt Peninsula or the neighbouring Bache Peninsula, Hall collected so much material that his Inuit assistant used the hood of her coat to carry "some fifty pounds of rock specimens" (Hall, 1864, p. 99 in the 1970 reprint).

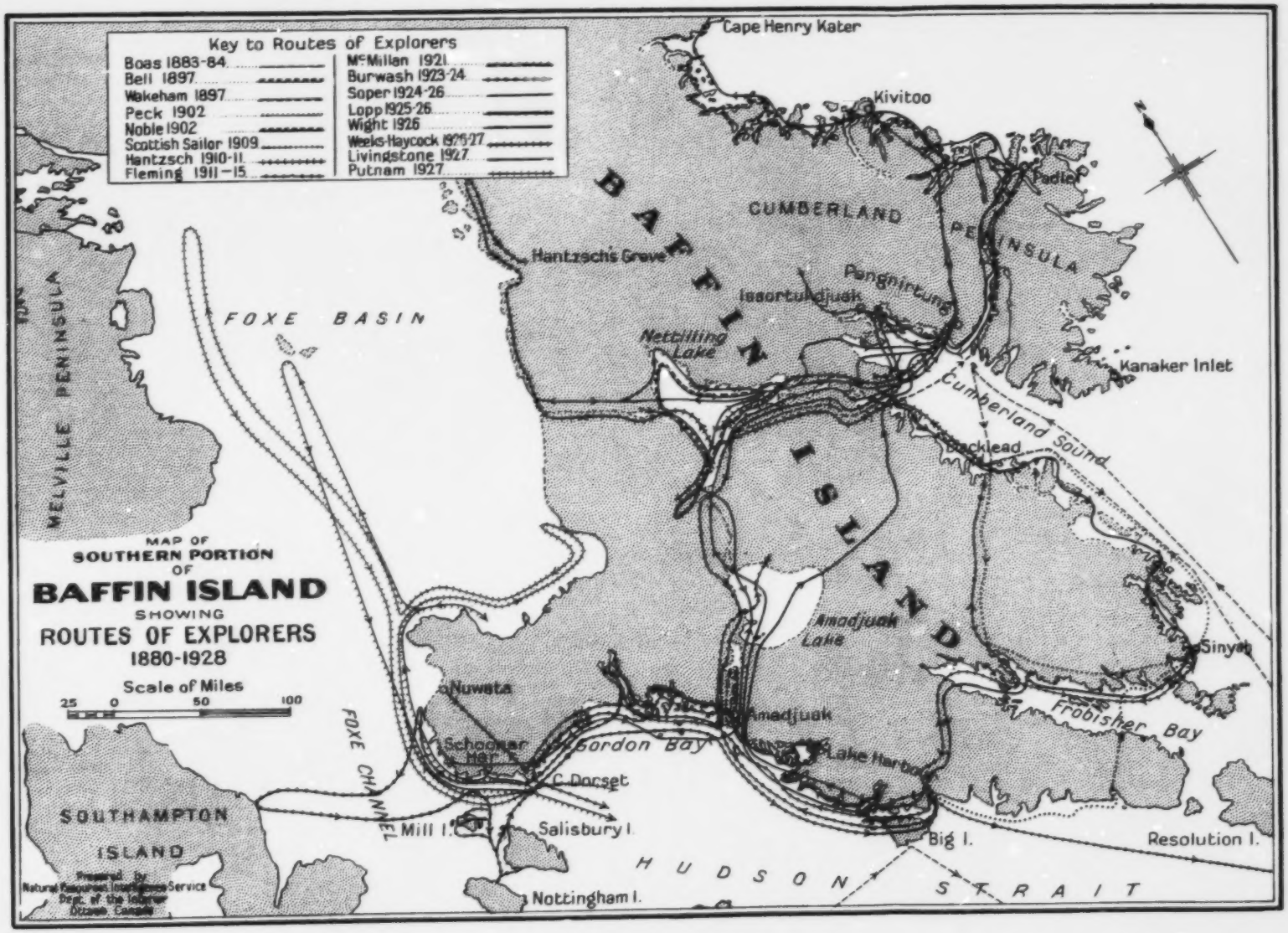

Figure 1. *Routes of southern Baffin Island explorers, 1880–1928. From Millward (1930). Note the lack of exploration through the Foxe Lowland (head of Frobisher Bay west past Amadjuak Lake to Bowman Bay on Foxe Basin). [original figure in colour]*

The second and more significant lot of fossils was collected during Hall's journey to the head of Frobisher Bay. It was there at an encampment that he was given fossils by an Inuit, Koojesse. These fossils were likely from a set of small rocky hills near the head of Frobisher Bay (Fig. 2). Hall named these hills Silliman's Fossil Mount (Section 10 of this volume) after Professor Benjamin Silliman, Jr. of New Haven, Connecticut (son of the founder of the American Journal of Science), and over the course of a couple of hours on-site, he made a small collection of seven species (Hall, 1864, 1970, p. 374; Roy, 1941; Miller et al., 1954). The seven species were given to the New York Lyceum of Natural History and were identified (but not described or illustrated) by Stevens (1863). The discussion by Stevens indicates they were Early Silurian in age (correlations made with Chazy limestone and Trenton beds).

Hall mounted two more expeditions to the north; the next (1864–69) was an attempt to search King William Island for evidence of Franklin (Hall, 1879). His last, in 1871, as Captain of the U.S. Navy tugboat *Polaris*, was an attempt to reach the North Pole. This was a disaster – Hall was murdered in 1871, part of the party drifted southward nearly 3,000 km on an ice floe for almost a year before being found, and the other survivors were rescued in 1873 (Mowat, 1973). However, it must be acknowledged that until the last voyage (and it must be emphasized that he died before the expedition fell apart), Hall had considerable success notwithstanding his lack of training. He found that Frobisher Strait was a bay, explored southern Baffin Island, Melville and Boothia peninsulas and as far west as King William Island, travelled into Hudson Bay and to the edge of the polar sea by northern Ellesmere Island and Greenland, contributed numerous geographic names, and found relics of both Frobisher's and Franklin's voyages. Hall's interest in Frobisher was partly due to the fact that even after 300 years the Inuit had oral accounts of the explorer, and Hall believed that the relatively recent disappearance of Franklin would be similarly recorded. Most significantly though, Hall recognized that the secret of survival in the north was following the habits of the indigenous people. Other explorers did not recognize this necessity, or chose to ignore it, to their regret. Hall was a pioneer of successful Arctic exploration whose accomplishments have often been ignored or forgotten, but in the words of Mowat (1993, p. 434), "he was as great a figure as any who have faced the ice, before his time or after".

Figure 2. *Silliman's Fossil Mount. Reproduction of woodcut from Hall's (1864) narrative reprinted in 1970.*

Hall's Inuit collector was not the last amateur paleontologist to contribute to the geological story of the area. Miller et al. (1954, p. 7) stated that a native gave specimens to "G. Cromer, Esq. of Boston", which were forwarded in 1896 to Franz Boas, an ethnologist. The Cromer fossils were reported on by Whitfield (1900, p. 21–22). Roy (1941, p. 44) noted that the "circumstances under which Cromer secured the fossils, consisting of fourteen species, are not known", but Miller et al. (1954) presumed they were from Silliman's Fossil Mount. This collection consisted of 26 specimens (Roy, 1941, p. 184).

Chronologically, Boas was the next important explorer of the Lowland. He lived on Baffin Island during 1883–84, and was based initially at a whaling station on Cumberland Sound. He explored about 2900 km of coast and interior by boat and sledge, and made a trip made in 1884 from Amadjuak Bay on the southern coast inland to Amadjuak Lake (Boas, 1887). Another fossil collector, Reverend Edmund J. Peck, obtained four pieces of Trenton fossils from drift at Nettilling Lake (Kindle, 1896; Bell, 1901, p. 21M). The first geologist from the Geological Survey of Canada to visit the island also was assisted in geological observations by his guide (see below).

The first visit to the Baffin region of Hudson Strait on behalf of the GSC was made by Robert Bell (Armstrong, 1947). Bell was not new to northern exploration; he had previously been in the lowland of Hudson and James bays, and also had passed through the Strait in 1880 where he recognized hills of "Laurentian gneiss" (Bell 1881, p. 21C). In 1884, Bell was the geologist (and medical officer, photographer, surveyor, and taxidermist) for the expedition of the sealing steamship *Neptune*, the purpose of which was to establish six meteorological observatories in the north (Bell, 1885). Three stations were placed on mainland Labrador and Quebec, one on Big Island near southern Baffin Island, and the other two on islands within Hudson Bay. On this voyage they crossed Hudson Bay to

Chesterfield Inlet and then sailed south as far as York Factory (Bell, 1885; Bell *in* Selwyn, 1886, p. 17A). The purpose of the return trip on the steamship *Alert* the following year was to retrieve the data and observation parties. During these voyages, they visited a number of islands off the southern coast of Baffin Island, and "went ashore at some parts" (Bell, 1901, p. 27M).

In 1885, on pans of consolidated pack ice off Big Island, Bell (1886, p. 9DD) found fragments of fossiliferous limestone, and identified *Receptaculites Oweni*; these "would point to the occurrence of Silurian rocks on or near the great bays in the west part of the north-shore of the Straits, where the land is said to be low." Bell's later interpretation, having examined the bays and finding no outcrop, was that the source was the Trenton beds of Silliman's Fossil Mount. The limestone pieces were thought to be transported by stream to shore-ice and then by current around Meta Incognita Peninsula (Bell, 1901, p. 16–17M).

Bell returned to Hudson Strait and Hudson Bay in 1897 as part of the Department of Marine and Fisheries' cruise of the sealing steamer *Diana* (Bell *in* Dawson, 1899, p. 74–83A). The GSC sent two parties aboard the *Diana*, with A.P. Low leading an expedition to the southern shore of Hudson Strait (Millward, 1930, p. 27). As before, Bell explored the southern coast of Baffin Island, but unlike on his previous explorations, he managed this time to travel inland. Bell journeyed from Amadjuak Bay northeastward toward Amadjuak Lake. He made it as far as Mingo Lake but is not clear if he reached Amadjuak Lake. Concerning the latter, it "was also seen and bearings taken to various points on its shores" (Bell, 1901, p. 6M), and it "proved to be upwards of fifty miles inland" (p. 11M). Later he does imply that he reached the lake by stating that the "Eskimo guide who accompanied me to Lake Amadjuak in 1897..." (Bell, 1901, p. 17M). On the other hand, Bell's geological map (Map No. 699), shows only the geology to Mingo Lake, and the only post-Laurentian stratum illustrated on Baffin Island is the "Trenton formation" of Silliman's Fossil Mount (Fig. 3). On the return journey back home, Bell landed at Akpatok Island in Ungava Bay, from which he collected about 90 fossils (Bell *in* Dawson, 1899, p. 83A).

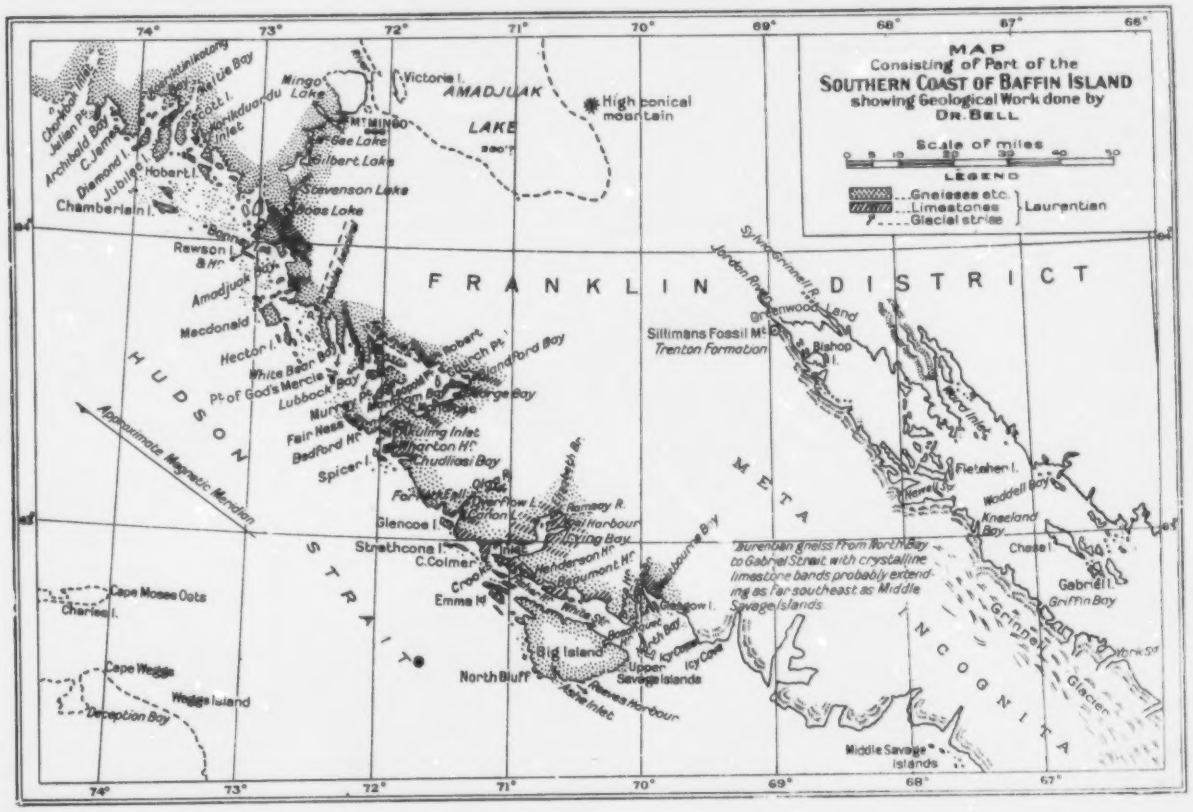

Figure 3. *Robert Bell's 1897 geological mapping of southern Baffin Island (from Millward, 1930). This was redrawn for Millward's report from the GSC's Map 699 (map dated 1900; in Bell, 1901), which also shows the work of A.P. Low on the southern coast of Hudson Strait.*

Bell made use of important observations made by Boas, who had lived on Baffin Island during 1883–84. For example, he quoted Boas as saying "Through the occurrence of the Silurian rocks on the Nettilling (Lake) the discovery of the same formation at the upper end of Frobisher Bay increases in value. We must now suppose that the Silurian limestones, which appear at Prince Rupert's Inlet, extend from there to Frobisher Bay, and overlie the granite and gneiss of Baffin's Bay and Davis' Strait. We will not be far astray if we connect this extensive Silurian district with the limestones that occur to the south of Igluling, and which form the flat eastern half of Melville Peninsula" (Bell, 1886, p. 9DD).

In Dawson's summary for 1897, Bell reported that he found fossiliferous fragments in increasing amounts during his journey from Amadjuak Fiord (sic) to Mingo Lake. Near Mingo Lake, he found two specimens of "a species of *Pentamerus*, which is closely allied to *P. decusatus*, if not identical with that form. These limestone fragments are like the rock of Mansfield Island, which, from the fossils I collected there in 1884, appears to be of the age of the Niagara formation" (Bell *in* Dawson, 1899, p. 81A). Bell's guide noted that flat-lying beds of similar rock by Nettilling Lake extend to Amadjuak Lake, as well as to Foxe Basin, and Bell interpreted this as meaning that "Niagara limestone may occur" there as well (Bell *in* Dawson, 1899, p. 81A).

Contrary to Boas' suggestion that the limestones at Frobisher Bay were an extension of the limestones at Amadjuak and Nettilling lakes, Bell realized that Silliman's Fossil Mount was "not only not connected with the latter..." but was also older: Lower Silurian (his Trenton) versus his Middle Silurian Niagaran (Bell, 1901, p. 16-18M). The fossils corresponded with those he collected on Akpatok Island in 1897, and to fossils on the Nelson River, at Stony Mountain and on the west side of Lake Winnipeg (Bell, 1901, p. 16M). He wrote further (p. 18M) that it is "therefore, probable that the great limestone trough of Fox Basin, is chiefly, if not altogether, of Silurian age."

Miller et al. (1954, p. 21) suggested the Niagaran date "was probably due largely to the fact that the collections contained the coral *Halysites*, which was formerly thought to be characteristic of the Silurian, but is now known to be widespread in the Upper Ordovician and to range down into the Middle Ordovician". Miller also noted (p. 21) that the term "Ordovician" corresponds to "Lower Silurian" of Bell's time. The term Ordovician, introduced in 1879, was not in common use at the time of Bell's writings, although Yochelson (1991) credits the first use of the word in the New World to the GSC's T. Sterry Hunt in 1883. In the late 1800s most in the GSC used the term Cambro–Silurian as an equivalent term, but in 1891 Sir William Dawson used the word Ordovician in a book on Acadian geology (Yochelson, 1991). Its universal acceptance was gradual; Berry (1987, p. 99) noted that the U.S. Geological Survey did not adopt the term until 1903. In GSC publications the transition from the terms Cambro–Silurian to Ordovician took place between the summary reports for the calendar years 1908 and 1909.

Russell Williams Porter, Alfred Victor Shaw, and others of the Seventh Peary Arctic Expedition to northwest Greenland spent a few hours collecting at Silliman's Fossil Mount in 1897 (Schuchert, 1900). They landed at Cape Haven, explored many localities along the coast of Frobisher Bay, and ascended the Jordan River. They surveyed and described geographical, glacial and geological features (Cooke and Holland, 1978). Their collection of 71 (Roy, 1941, p. 44) or 72 species (Schuchert, 1914, p. 472) formed the basis for the later reports by Schuchert (1900, 1914), Bassler (1911), and Foerste (1928a, 1935). The earliest known photograph of Silliman's Fossil Mount was taken by Porter and reproduced in Schuchert (1900).

1900–1930

Crawford Noble Jr. was the son of the owner of whaling stations on Cumberland Sound, and during his five years on Baffin Island, he travelled extensively in both summer and winter. His longest trip was to Nettilling Lake, the first such trip recorded by a non-aboriginal. This is of importance to this narrative because the sketch map that he submitted to the Department of the Interior identified a "Large Block of Basalt". He studied birds and natural history, but unfortunately, later lost his journal of this expedition (Millward, 1930).

Albert P. Low was the next GSC officer after Bell to approach Baffin Island. This was as Commander and geologist on the voyage of the sealing steamship *Neptune* in 1903–04. They steamed past the southern coast of the island on their way to Hudson Bay in 1903 (Low, 1906, p. 13), and into Cumberland Sound on their return from the Arctic Islands in 1904 (Low, 1906, p. 62). Low (1906) drew a detailed summary of the geology of eastern North America and the Arctic Islands, including Baffin Island.

The first recorded crossing of the Foxe Lowland by a non-aboriginal man was made in 1910 by the German, Bernard Adolf Hantzsch. He and his assistants crossed from Cumberland Sound to Nettilling Lake, and along the Koukdjuak River. Hantzsch noted deposits of Precambrian rock rubble and limestone boulders rich in fossils at the western end of Nettilling Lake. Along the Koukdjuak River were erratic blocks of "primitive rocks", and limestones with large fossil snails (these might have been *Maclurites*). Hantzsch died in 1911 and was buried near the shore of Foxe Basin. His Inuit companions returned to Cumberland Sound with his diaries, collections and notes (Millward, 1930).

Renewed interest in Baffin Island in the 1920s resulted in several major expeditions, including the Fifth Thule Expedition of 1921–24, which circumnavigated the island, but worked only in the western part of Foxe Basin (western Baffin Island, Melville Peninsula) and on Southampton Island in northern Hudson Bay (Rasmussen, 1927). This Thule expedition overlapped chronologically with several other expeditions in the southern region of Baffin Island. Major L.T. Burwash was an exploratory engineer for the North West Territories and Yukon Branch, Department of the Interior, who undertook an economic survey of southern Baffin Island in 1923–24. Millward (1930, p. 50–62) gave a detailed account of Burwash's travels, quoting from his unpublished report and diary. Burwash described the geology only in general terms, but these can be interpreted to show he recognized the differences between the Precambrian terrain and the Paleozoic outlier. Concerning his trip from Cumberland Sound to Nettilling Lake... "The country is composed of rugged igneous rock until the portage from the salt water to Nettilling lake is reached." (Millward, 1930, p. 53). From Nettilling, Burwash's party of four turned south toward Amadjuak Lake, and at "the point we touched the lake the geological formation changed to limestone, which continued for some 40 miles then reverting to gneiss. By noon our dogs [one sledge and "sixteen good dogs" (p. 55)] were all in so we camped for the day under a high limestone cliff which forms one of the best landmarks in the country." (p. 56). "Along the western shores of the lake, the coast line is for the greater part very low... but at two points limestone cliffs occur which rise to an elevation of fifty feet above the level of the lake." (Burwash was describing the northwestern escarpment on the lake, probably near sections 14 and 15 of this volume). "About eight miles northerly from the southwestern angle of the lake the limestones disappeared, their place being taken by archean rocks which formation continued until Hudson strait was reached." (p. 58). Burwash travelled from Amadjuak Lake to Mingo Lake along a small river [Mingo River], and noted that Mingo Lake was "bounded on three sides by the same low-lying country that had maintained since leaving Nettilling lake but from its southern line rise the coastal mountains." Burwash continued toward Amadjuak Bay on the south coast, following "a chain of seven lakes" (p. 58). From Millward's account of Burwash's travels, it does not appear that he made note of fossils, or found anything more than a "trace of precious metals" in quartz veins (p. 60).

The National Museum of Canada's Baffin Island Expedition of 1924–26 had J. Dewey Soper as naturalist (Soper, 1928, 1930a). Soper had previous experience with the Museum's Canadian Arctic Expedition of 1923, and returned to Baffin Island in 1928 (below). His journeys out of Cumberland Sound were perhaps the most extensive of Baffin's explorers. He made six major trips, mostly by sledge, travelling more than 6400 km, and collecting more than a thousand specimens of birds, mammals, insects and plants, and a large number of rock and fossil specimens. He took about 600 photographs (Millward, 1930, p. 83). These excursions comprised two on Cumberland Peninsula (January through March, 1925); one to Nettilling Lake and surrounding areas (April–September, 1925), during which fossils were collected (Millward, 1930, p. 75); one across to Foxe Basin via Nettilling Lake (January–February, 1926); one to Nettilling Lake to pick up their cached collections and to cache for the later Cape Dorset trip (March–April, 1926); and finally, one to Amadjuak Bay and Cape Dorset via Nettilling, Amadjuak and Mingo lakes (April–August, 1926) (Millward, 1930). Soper's sketch map of Nettilling Lake and the Koukdjuak River (reproduced in Millward, 1930, p. 73) differentiates between the Precambrian ("Granite peneplain" and "Rugged granite hills" on the east side of the lake with the "vast flat tundra", "Gravel Hills" and "Coastal gravel ridges" covering Paleozoic strata on the west side of the lake. Collections of fossils made during Soper's trips still reside in the GSC collections. Miller et al. (1954, p. 22) reported that fossils were collected "from 'drift' on the islands and shores of Nettilling Lake, along the Koukdjuak River... and in the vicinity of Amadjuak Lake" by Soper in 1925 (Soper, 1928, 1930a, b). These fossils were studied by A.E. Wilson (1928, 1931).

In 1926–27, Ludlow J. Weeks and Maurice H. Haycock of the GSC carried out a winter traverse based from Pangnirtung, during which they investigated both Precambrian and Paleozoic terrain. In spite of a serious hunting accident had by Weeks (Zaslow, 1975, p. 350), they worked around the head of Cumberland Sound, and west from Nettilling Fiord to Nettilling Lake (Blackadar, 1967a). Rocks on the eastern side of Nettilling Lake were found to be intrusives, but they also reported outcrops of Paleozoic rocks farther west (Weeks, 1928, p. 90c).

In 1927, members of the Putnam Baffin Island Expedition explored the western portion of the Lowland, with L.M. Gould of the University of Michigan making fossil collections. The expedition was led by publisher George Palmer Putnam of New York (best known now as the husband of aviatrix Amelia Earhart; Chapman, 1997) and sponsored primarily by the American Geographical Society (Putnam, 1928; Gould, 1928a, b). Putnam was similar in some ways to the earlier explorer, C.F. Hall. He also was a writer and publisher, although more successful. After writing popular stories on other explorers, he felt that it was time to do more, and so organized an expedition. Also like Hall, he did not have a scientific background (Chapman, 1997), but he equipped his party with experts in a number of fields to make the scientific records and collections for several institutions. Members of the party explored the north coast of Foxe Peninsula, and worked inland from Bowman Bay to Putnam Highland (Gould, 1928b; Millward, 1930; Blackadar, 1967a). They made a significant contribution by correcting the original charts of the eastern margin of Foxe

Basin on Baffin Island. This correction resulted in their comment that "an area larger than the state of Connecticut has, cartographically speaking, been sunk beneath the surface of Foxe Basin" (Putnam, 1928, p. 1). A geological map of the area by Gould (1928a, p. 21) identified "Ordovician" sedimentary rocks, which were called the "Putnam Formation" (p. 23) and "pre-Cambrian" igneous and metamorphic rocks. Gould (1928a, p. 22–23) reported that although the limestones were highly fossiliferous, "only the fact that but two or three hours were available for collecting and that the materials collected had to be carried out to our boat on our backs, a distance of about forty miles, prevented us from securing a much more comprehensive collection". Nonetheless, the Putnam collections were significant enough for the cephalopods to be studied by Foerste (1928b), and other fossils reported on by Hussey (1928).

In the same year that the Putnam group was exploring the western end of the Lowland, members of the 1927–28 Rawson–MacMillan Subarctic Expedition were studying the eastern portion. This expedition was from the Field Museum of Natural History in Chicago and was co-sponsored by the National Geographic Society. They followed the coast of Labrador to Frobisher Bay, collecting and making observations on the anthropology, botany, geology, and zoology. Sharat K. Roy served as geologist, and his chief task was to make fossil collections from Silliman's Fossil Mount. As a result of the extreme tides, they anchored at Bishop's Island, with about 5 km of tidal flats between them and the Mount. It is not clear exactly how much time they had to collect at the Mount, but they arrived on August 17, and left their anchorage two days later (Roy, 1941).

Roy (1941) noted that only three previous collections had been made from the Mount. Two lots of fossils were collected by Hall (see above), but one lot was from drift material, and the seven specimens from the Mount could not be found for examination (Roy, 1941, p. 182). The second, the Cromer collection, is believed to have been lost (Roy, 1941, p. 184-185). The third, the Porter collection of 1897, was the largest of the three, but most are with the United States National Museum, the remainder being in the American Museum of Natural History (Roy, 1941, p. 11, 185). Roy's collections were much larger – 68 genera and 116 species (Roy, 1941, p. 44) and were reposited with the Field Museum of Natural History.

Soper (see above) returned to Baffin Island in 1928 on behalf of the North West Territories Branch of the Department of the Interior. Between 1928 and 1929 he travelled a distance of more than 3700 km on Foxe Peninsula and western Baffin Island. One of his five trips, in April of 1929, was to Putnam Highlands, where he made a collection of fossils, despite the country being "deeply snow-mantled" (Soper, 1930b, p. 416).

1940–1979

The next period of exploration began in 1947 and continued through to the mid-1960s. A.K. Miller (State University of Iowa), who earlier assisted Roy in identifying the cephalopods Roy had collected (Roy, 1941, p. 11), spent ten days with Walter Youngquist on Baffin Island (but only three at the Mount) in 1947. Results of Miller's studies of their fossil collections, as well as those collected by Gould during the 1927 Putnam Expedition, were published in a Geological Society of America Memoir (Miller et al., 1954). The memoir also included a paper on trilobites by H.B. Whittington based on material collected during Miller's 1947 visit, Roy's expedition of 1927, and collections from 1897, which had been described by Schuchert (1900). Three fragmentary graptolites on a small nautiloid were also described in a short note by C.E. Decker in the same monograph. Miller et al. (1954, p. 6) made an airborne survey north of the Mount and noted a larger outlier on the Jordan River (sections 11–13 of this report). This, they said, might have been the locality mentioned previously by Hall and Porter on their respective 1861 and 1897 trips. The GSC's Yves O. Fortier and Alice E. Wilson contributed notes and lists on "upper Richmond" fossils found from the Jordan River outlier to the memoir by Miller et al. (1954). The Jordan River outcrops and outlier are two of the fossil localities in the present study. Miller et al. (1954, p. 44–45), studied more than 86 genera of cephalopods, brachiopods, trilobites, ostracodes, bivalves, gastropods, corals, graptolites, and others; these were reposited with the United States National Museum, with the remaining collection of duplicates divided between the GSC and State University of Iowa (Miller et al., 1954, p. 3).

During a cruise of James and Hudson bays and Foxe Basin by the Geographical Bureau (Department of Mines and Resources) in 1949, stops were made at a number of localities on western Baffin, eastern Melville Peninsula, and nearby islands. Ordovician and Silurian fossil collections were identified by A.E. Wilson (*in* Burns, 1952).

Fortier and W.L. Davison continued the GSC's study of Baffin Island in 1949. The goal was a reconnaissance of the geology south of latitude 66°N. They began with the coastal area of Meta Incognita Peninsula between Frobisher Bay and Lake Harbour. Davison continued his coastal studies for the next two years, and also mapped the north shore of Frobisher Bay and eastward in 1950 (Blackadar, 1967a). Further work on the southern coast was done by Davison in 1953 (unpublished GSC annual report - calendar year 1958). Robert G. Blackadar's studies of southern Baffin Island continued from 1958 through 1961 and 1964 (unpublished GSC annual reports - calendar years 1958–61; Blackadar, 1967a), and included work on the Mingo Lake–Macdonald Island map area (Blackadar, 1967b). Operation Admiralty in 1963, led by Blackadar, covered northwestern Baffin, and included Hans P. Trettin's study of the Paleozoic strata.

Trettin's interest in the area studied during Operation Admiralty and in the islands and the western Baffin Island coastline in the Foxe Basin continued with his work in 1968 on the geology and petroleum potential of these strata (Trettin, 1969). Part of Trettin's study area had previously been investigated by the Fifth Thule Expedition of 1921–24, by Burns in 1949, and by Blackadar (see above).

Planning for Operation Amadjuak began in 1963; reconnaissance for planning was carried out and fuel caches deposited in 1964, and fieldwork done in 1965 (Blackadar, 1966, 1967a). This was a helicopter- and float plane-supported project with Blackadar, F.C. Taylor, and others of the GSC. During the course of this project, they completed the mapping of 130 000 km^2 of Precambrian and Ordovician strata on southern Baffin Island (Blackadar, 1967a). Glacial geology was studied by W. Blake, Jr. and F.M. Synge (Blake, 1966a, b). Fossils collected by Blackadar's party from forty-five localities were identified by G. Winston Sinclair of the GSC, who distinguished three faunas of different Ordovician age.

Blake's work in 1965 was the first study of moraines and deglaciation chronology in southern Baffin Island (Blake, 1966b). Paleozoic erratics were commonly noted in historical reports. Although Paleozoic strata do not outcrop in eastern Baffin Island, collections of erratics were made during the 1963–67 Baffin Island Research Project of the Geographical Branch (Canada Department of Mines and Technical Surveys), which supported a number of glacial geomorphology and chronology studies. Andrews and Miller (1979) estimated that the ages of various erratics ranged from Middle Ordovician to Silurian. Interestingly, erratics from York Sound on the west side of Frobisher Bay "yielded a Late Ordovician fauna with trilobites similar to specimens from Akpatok Island, Hudson Strait." Their interpretation was that the erratics were essentially the same age as strata of Foxe Basin and offshore of Hall Peninsula. The offshore collections comprised four cores collected on the 1975 cruise of the CSS Hudson. Two of these lithologically and faunally resembled the rocks of Silliman's Fossil Mount and of Akpatok Island. The other samples were fossiliferous and bituminous limestones similar to those also found on Akpatok, and to strata of northwestern Baffin Island (MacLean et al., 1977).

1980–1997

Just over a century after the start of Bell's work on Baffin Island, personnel from the GSC returned between 1986 and 1989 to study in more detail the Paleozoic "oil shales", stratigraphy, and paleontology (Macauley, 1987; Sanford and Grant, 1990). George Macauley and N. Jack McMillan searched for and studied "oil shale" strata for five days. They visited sites at Nuvungmiut River (near Section 5 of this volume), Silliman's Fossil Mount (Section 10), Jordan River (sections 11–13), and Amadjuak Lake (sections 14, 15). Macauley's (1987) conclusion was that oil shales were found in two apparently separate zones on Baffin Island.

The 1988 GSC field party comprised Bruce V. Sanford (Ottawa), Alan C. Grant (Dartmouth), and Alexander D. McCracken (Ottawa). This survey linked previous geological studies:

- Blackadar's reconnaissance of southern Baffin Island in 1965
- Tens of thousands of kilometres of offshore geophysical tracks, by Sanford, Grant, and others of the Bedford Institute of Oceanography, in Frobisher, Hudson, and Ungava bays, Foxe Basin, Hudson and Davis straits (various cruises on *CSS Dawson*, *CSS Hudson*, and *CCGS Labrador* and *CCGS d'Iberville* between 1965 and 1971, and *CSS Hudson* from 1975 to 1993)
- Sanford and W.W. Heywood's onshore work on Southampton, Coats and Mansel islands between 1968 and 1970
- Trettin's work in 1968 and 1973 on Melville Peninsula and northern and central Baffin Island
- Sanford and Thomas E. Bolton's work in 1973 on Melville Peninsula [brief historical summaries for the Southampton Island area and western Foxe Basin are given in the geological reports by Blackadar (1967a), Heywood and Sanford (1976), Trettin (1975) and Bolton (1977)]

Sanford's Baffin party was able to work only four of seven days because of bad weather and mechanical problems with the helicopter, but still they left with considerable data. McCracken returned to the island with Gregory P. Martin (Ottawa) in late August of 1989. Again, poor weather and problems relating to helicopter support were factors in limiting fieldwork and in influencing the choice of section stops – five of eight days were available for work. Because of this, the closer a section was to the base at Iqaluit, the more likely it was to be studied (and restudied) over the two seasons (Sanford, Fig. 11, this volume).

The most ambitious recent GSC program was the effort to map in detail the Precambrian rocks during the period from 1993 to 1997 with David Scott, Marc St-Onge, and others. A series of maps was produced; two of the maps showed undifferentiated Ordovician limestone in the Lowland outliers (Scott and Godin, 1995; Scott et al., 1996; St-Onge et al., 1997).

Interest by non-scientists has continued with the 1996 American Expedition to Baffin Island led by writer and historian Sheldon Bart of New Jersey. This was an attempt to continue the geographical and geological exploration begun

by Putnam in 1927, concentrating on the area of the Putnam Highland at the western part of the Foxe Lowland. Only basic geological observations were made, which add little to previous interpretations (S. Bart, unpublished prospectus, letters and reports, 1996, 1997).

Interest in a geoscience knowledge base for the Baffin Region continues to grow since the formation of the new territory of Nunavut in 1999.

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GEOLOGICAL FRAMEWORK OF THE ORDOVICIAN SYSTEM IN THE SOUTHEAST ARCTIC PLATFORM, NUNAVUT

B.V. Sanford[1] and A.C. Grant[2]

Geological framework of the Ordovician system in the southeast Arctic Platform, Nunavut; in Geology and paleontology of the southeast Arctic Platform and southern Baffin Island, Nunavut; Geological Survey of Canada, Bulletin 557, p. 13-38.

Abstract

Ordovician strata of the southeast Arctic Platform comprise seven formations, six of which are elevated to formal status based on surface and subsurface geology and high-resolution seismic data.

The Canadian to Chazyan strata in Ungava Basin and Foxe Basin are lithologically dissimilar and are identified respectively as the Ungava Bay and Ship Point formations. The Ungava Bay Formation comprises sandstones and minor carbonates and shales, whereas strata of the Ship Point Formation are generally carbonates. The Ungava Bay Formation unconformably overlies Precambrian rocks and is disconformably succeeded by the Frobisher Bay Formation. The thin to thick, evenly bedded limestones of this formation contain the distinctive *Gonioceras–Labyrinthites* sponge megafauna of Blackriveran–Trentonian age.

The Amadjuak Formation, which disconformably overlies the Frobisher Bay Formation, is characterized by strata of Silliman's Fossil Mount on southern Baffin Island. These rocks are thinly to thickly bedded limestones, shaly limestones and shales of Edenian to mid-Maysvillian age. Basal beds contain petroliferous shales. The Amadjuak Formation on Akpatok Island is succeeded by the recessive, thin bedded, black, calcareous and petroliferous shales of the Boas River Formation, known best from its type locality on Southampton Island, and also in the subsurface of the southern Hudson Bay Basin. These shales are mid- to late Maysvillian in age.

The limestones and minor shales of the Akpatok Formation conformably succeed the Boas River Formation on Akpatok Island in the Ungava Basin. This has an age estimate of late Maysvillian–Richmondian. On Baffin Island, remnants of the Akpatok Formation are overlain by the Foster Bay Formation. The highest Ordovician (presumably Richmondian) unit on Melville Peninsula comprises laminated carbonates and associated pinnacle reefs.

Résumé

Les strates ordoviciennes de la partie sud-est de la Plate-forme de l'Arctique appartiennent à sept formations, dont six ont été définies de façon formelle sur la base de descriptions géologiques d'affleurements et de coupes souterraines, ainsi que de données sismiques haute résolution.

Les strates du Canadien au Chazyen dans les bassins d'Ungava et de Foxe sont différentes au plan lithologique et elles ont été attribuées respectivement à la Formation d'Ungava Bay et à la Formation de Ship Point. La Formation d'Ungava Bay est constituée de grès et d'une quantité moindre de roches carbonatées et de shales. La Formation de Ship Point, pour sa part, est formée surtout de roches carbonatées. La Formation d'Ungava Bay repose en discordance sur les roches précambriennes et est surmontée en disconformité par la Formation de Frobisher Bay. Les calcaires qui composent cette formation sont disposés en couches de faible à grande épaisseur et montrent une stratification uniforme. Ils contiennent une mégafaune caractéristique de spongiaires à *Gonioceras–Labyrinthites* qui révèle un âge du Blackrivérien au Trentonien.

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Dans le sud le l'île de Baffin, la Formation d'Amadjuak, qui repose en disconformité sur la Formation de Frobisher Bay, est révélée de manière caractéristique par les strates du mont Silliman's Fossil. Celles-ci sont constituées d'une succession de calcaires, de calcaires argileux et de shales disposés en couches de faible à grande épaisseur et dont l'âge varie de l'Édénien au Maysvillien moyen. Les couches basales contiennent des shales pétrolifères. Dans l'île Akpatok, la Formation d'Amadjuak est surmontée d'une succession en retrait de minces lits de shales calcareux et pétrolifères de couleur noire. Cette succession est attribuée à la Formation de Boas River. Cette unité est mieux connue pour ses strates qui affleurent à la localité type dans l'île Southampton, mais aussi pour ses couches situées en profondeur dans la partie sud du bassin de la baie d'Hudson. Ces shales remontent au Maysvillien moyen et tardif.

Dans l'île Akpatok, située dans le bassin d'Ungava, les calcaires et, secondairement, les shales de la Formation d'Akpatok surmontent en concordance les unités de la Formation de Boas River. L'âge de la Formation d'Akpatok se situerait au Maysvillien tardif– Richmondien. Dans l'île de Baffin, des lambeaux de la Formation d'Akpatok sont surmontés d'unités de la Formation de Foster Bay. Dans la presqu'île Melville, l'unité ordovicienne qui occupe la position la plus élevée (probablement du Richmondien) se compose de roches carbonatées laminées auxquelles sont associés des pinacles récifaux.

INTRODUCTION

Although the presence of Ordovician strata in the southeast Arctic Platform (Fig. 1) was established prior to the turn of the century (McCracken, this volume), only in the more recent past has any attempt been made to classify and map the rocks on a systematic basis. During the course of geological mapping on southern Baffin Island and Melville Peninsula, Blackadar (1963, 1967, 1970) examined and classified the rocks on a broad reconnaissance scale. This was followed by the comprehensive and detailed geological mapping of much of Foxe Basin by Trettin (1975), and stratigraphic investigations of Melville Peninsula by Bolton (1977) and Sanford (1977). More recently, detailed maps of southern Baffin Island were published by Scott et al. (1996) and St-Onge et al. (1997). These are part of a series of maps that concentrate on the Precambrian geology, and only illustrate the undifferentiated Ordovician strata of Silliman's Fossil Mount and the other outliers in the Hone River–Jordan River area.

In 1988, B.V. Sanford, A.C. Grant, and A.D. McCracken conducted a reconnaissance survey of the Ordovician strata on southern Baffin Island that enabled the construction of a geological map for the eastern segment of Foxe Basin, which was compatible with maps of western and central parts of the basin constructed earlier by Trettin (1975). Fossils from this and the 1989 field season are reported in this volume by the following writers: Bolton (megafossils), Copeland (ostracodes), McCracken (conodonts), Riva (graptolites), and Asselin, Achab, and Soufiane (chitinozoans).

A much improved understanding of the surface and subsurface geology of Akpatok Island in Ungava Bay was forthcoming from investigations carried out during the drilling of Premium Homestead Akpatok L-26 well in 1969 (Workum et al., 1976). In adjacent offshore areas beneath the waters of Ungava Bay, Hudson Strait, and Foxe Channel, much new information has come to light concerning the distribution, age, and lithological character of the Ordovician succession from the comprehensive network of shallow, high-resolution seismic data (Fig. 2) and shallow borehole data obtained by scientists from the Bedford Institute of Oceanography (BIO); e.g., Grant and Manchester (1970) and MacLean et al. (1986). Further interpretation of the BIO marine seismic data by the present writers, along with detailed examination of the cuttings samples and cores from Premium Homestead Akpatok L-26 and lithic samples collected from cliff sections on Akpatok Island, has provided a useful database from which to piece together a geological map of this mainly offshore segment of the southeast Arctic Platform (Fig. 3, in pocket).

To identify the rock units that more clearly define the succession of depositional events that occurred during the Ordovician period throughout the southeast Arctic Platform (Fig. 4 –12), several new formation names were informally introduced by Sanford and Grant (1990). The purpose of this paper is to formalize the terms proposed by the above authors, and to describe and define the distribution of the rock units in greater detail than was possible in their brief summary report of 1990 (Fig. 4).

The broad lithological similarity of the Ordovician succession throughout the southeast Arctic Platform suggests that the various preserved remnants shown in Figure 3 were originally interconnected, and their present separation reflects local basement uplift and erosion in more recent periods of geological time. The high topographical relief of the Precambrian terrain observable along the shores of Hudson Strait, and along the Paleozoic boundary on Melville Peninsula and in southwest Baffin Island, where

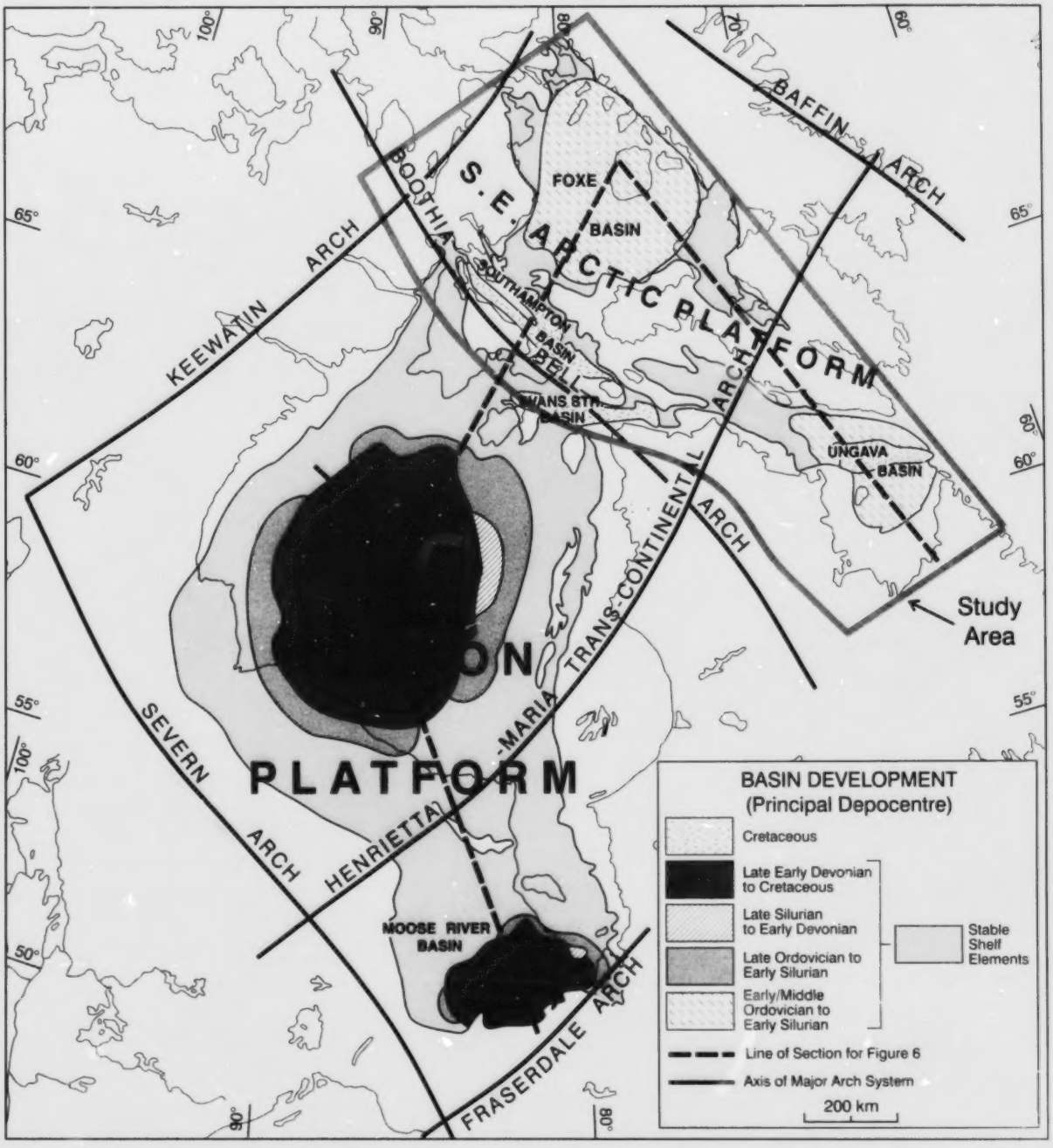


Figure 1. *Phanerozoic tectonic elements - Hudson and southeast Arctic platforms.*

Precambrian rocks rise abruptly above and are locally in fault contact with the relatively flat-lying Ordovician strata, provides conclusive evidence of widespread vertical tectonic movements within and bordering the region subsequent to Ordovician time.

In Foxe Basin (Fig. 3), where Ordovician rocks are exposed above sea level on Melville Peninsula, southern Baffin Island, and adjacent offshore islands, the somewhat variable weathering characteristics of the rocks have resulted in two quite distinctive physiographic elements. First are

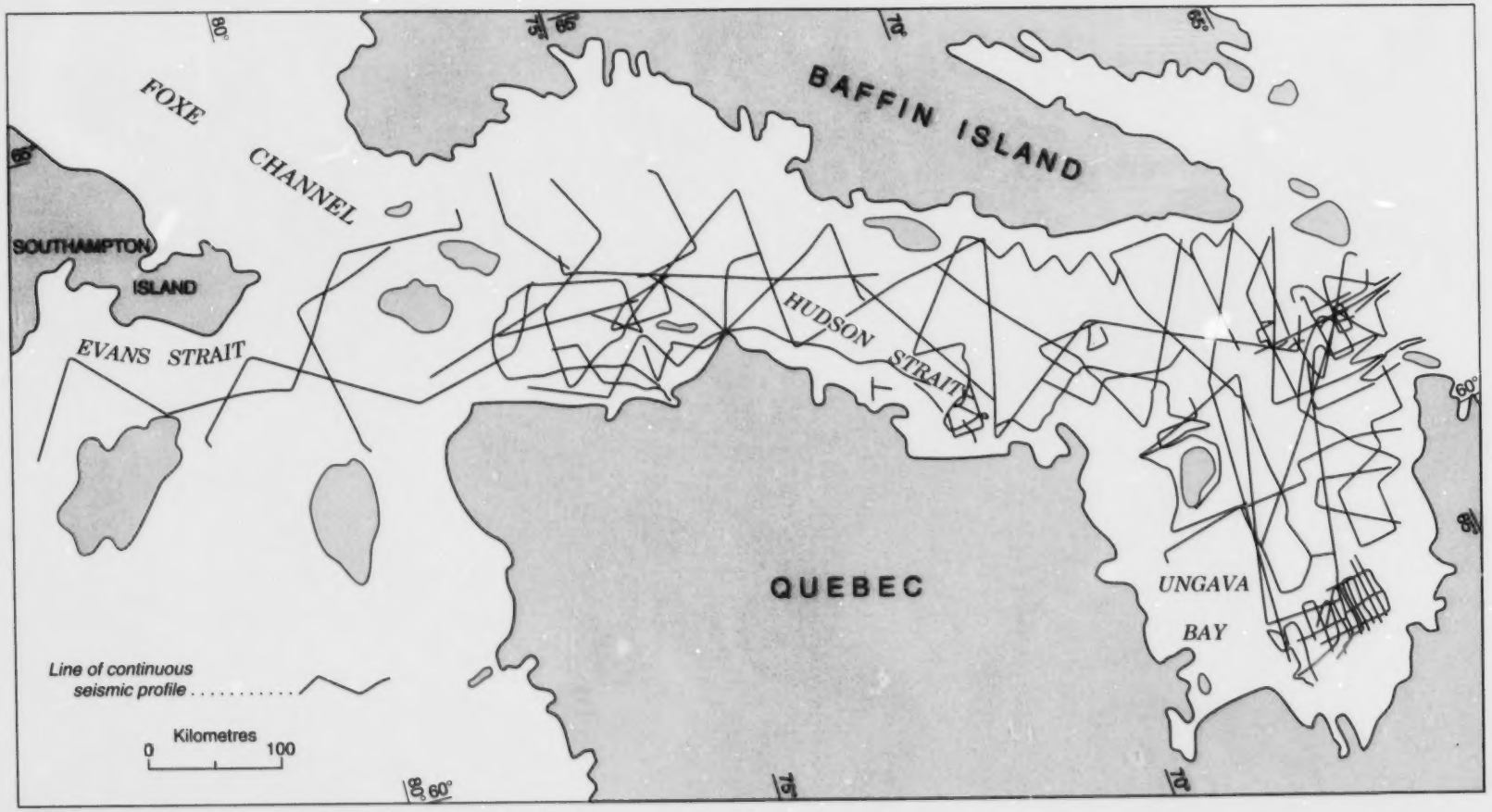


Figure 2. *Bedford Institute of Oceanography shallow reflection seismic surveys carried out in 1966, 1968, 1971 (CCGS Labrador and CSS Dawson), 1982, 1985, 1986, 1987, 1992, 1993 (CSS Hudson).*

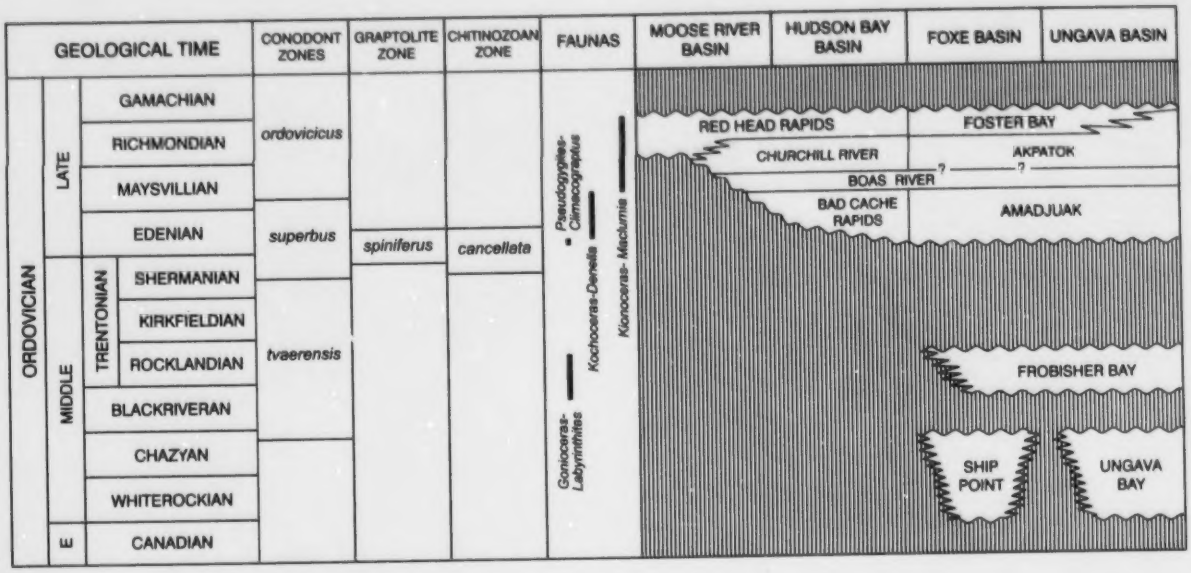


Figure 4. *Ordovician stratigraphic framework.*

extensive areas of low, swampy and grassy tundra (Fig. 13) commonly floored by softer carbonates and shales of the Amadjuak and Ship Point formations. These areas are characterized by numerous lakes, of which Hall Lake in Melville Peninsula, and Amadjuak and Nettilling lakes on Baffin Island are the largest. Such low swampy areas have wide extent, particularly on Baffin Island, where this terrain is referred to as the "Great Plain of the Koukdjuak". Second are areas where the tundra gives way at slightly higher levels to gravels (Fig. 14), locally derived from the more resistant-weathering upper strata of the Amadjuak Formation exposed here and there around the margins of the basin. These gravels occur as raised beaches that developed during isostatic rebound along the receding shoreline of the Pleistocene Tyrrell Sea (Craig, 1969). Within this terrain, prominent escarpments and buttes are locally developed, some of the more spectacular of which occur on Melville Peninsula and southern Baffin Island. In the latter area they form the Putnam Highland, and the abrupt escarpment that forms the western shoreline of Amadjuak and Nettilling lakes. From their outcrop belt around the margins of Foxe Basin, Ordovician strata dip concentrically in a basinward direction beneath younger strata of Early Silurian age (Fig. 7).

In contrast to Foxe Basin, where Ordovician rocks are quite well exposed, the stratigraphic framework beneath Ungava Bay, Hudson Strait and Foxe Channel has had to be pieced together from the rocks exposed on Akpatok Island (Fig. 15–17) and the subsurface succession encountered in the Premium Homestead Akpatok L-26 well, these two sources of information tied into the seismic stratigraphy as interpreted in the adjacent offshore regions.

The Ordovician strata that floor much of Hudson Strait and Ungava Bay are, for the most part, relatively undeformed. However, major faulting has been interpreted from seismic and bathymetric data (Fig. 5) at the eastern end of Hudson Strait where it borders Ungava Bay (Fig. 8) and very extensive faulting has been noted beneath Foxe Channel. In both of these areas, rocks interpreted as Ordovician on seismic profiles are inferred to dip at fairly abrupt angles beneath sediments of Cretaceous age (Fig. 3). Beneath Hudson Strait, Foxe Channel, and Evans Strait, Ordovician strata lie at substantial depths (300–900 m, Fig. 5). In Ungava Bay on the other hand, the same beds form a broad plateau, generally at depths of 100 m or less.

The Ordovician strata of Hudson Strait and Ungava Bay, as in Foxe Basin, are characterized by major escarpments along their erosional edges. Detailed bathymetric data thus provide very useful information in the geological mapping of these offshore regions (Fig. 5; Grant and Manchester, 1970, fig. 2). The preservation and possible extension of Akpatok Island into surrounding offshore areas has long been a source of interest and speculation. The investigations of Workum et al. (1976) and the present study have firmly established that the Upper Ordovician rocks that form Akpatok Island are an erosional remnant of a major rock unit (Akpatok Formation), which has been reduced to its present size and configuration by marine and subaerial(?) erosion. The island, largely bounded by sea-cliffs, rises to an elevation of nearly 280 m. The strata that form the walls of the island appear to be relatively flat lying, but regional investigations of the Ungava Bay region by the writers suggest that the regional dip is at a low angle to the northeast.

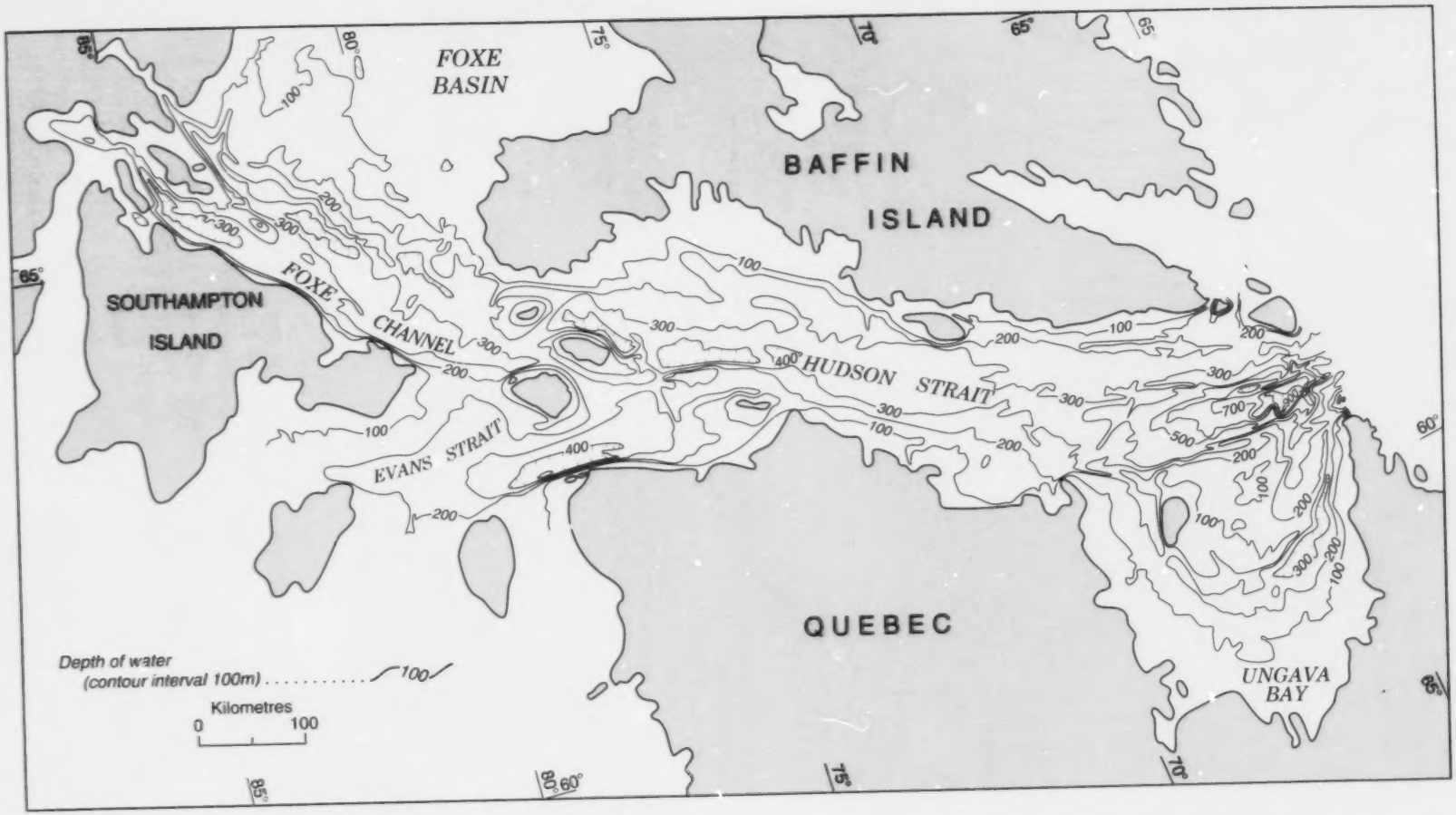


Figure 5. *Bathymetric configuration of the seafloor: Ungava Bay, Hudson Strait, Foxe Channel and Evans Strait.*

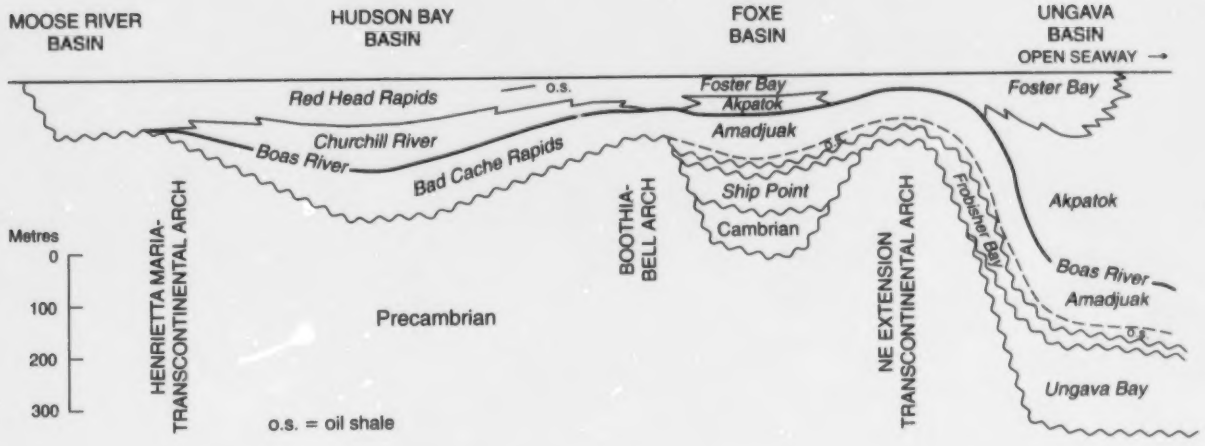


Figure 6. *Stratigraphic relationships of the Ordovician succession.*

REGIONAL GEOLOGICAL SETTING

The Ordovician rocks that form the southeast Arctic Platform (Foxe Basin, and beneath the waters of Hudson Strait and Ungava Bay) are erosional remnants of a much broader cratonic cover that once mantled much of the Canadian Shield. These remnants were directly connected to the central and western Arctic Platform to the north from late Early and early Middle Ordovician (Canadian/ Whiterockian) to Late Ordovician (Richmondian) time, and with the adjoining Hudson Platform (Fig. 1, 6) throughout much of the Late Ordovician (mid-Edenian to Richmondian) time (Fig. 4). From the Hudson Bay Basin, the strata lay across the Severn Arch to the south to connect with Upper Ordovician rocks of the Interior Platform and by an indirect seaway around the Fraserdale Arch with the St. Lawrence Platform.

The Precambrian terrain (major arch systems) that borders Paleozoic remnants in the southeast Arctic Platform and surrounds the Hudson Platform to the south was tectonically active from time to time during the Phanerozoic, and principally so at or near the close of the Early Silurian Llandovery, and again in Cretaceous (Aptian to Cenomanian) time. Almost without exception Ordovician strata thin toward the positive basement features (Fig. 6) and some rock units can be seen to wedge-out completely where they approach the structurally higher segments of the arches. The latter were thus undoubtedly positive structural elements during the Ordovician Period, and may well have had their tectonic origins coincident with much earlier orogenic events in the Archean and/or Proterozoic. One important structural element that undoubtedly affected and controlled initial Ordovician depositional processes was the Boothia–Bell Arch, which trends in a southeast direction from the central high Arctic to Southampton Island, passing beneath what is now western Hudson Strait and continuing into northern Quebec. The arch is known to have been tectonically active as early as the Proterozoic, again in the Early Silurian (late Llandovery), and during Early and Late Cretaceous times. It is still active, as evidenced by the preponderance of contemporary earthquake epicentres that parallel its axis.

The Boothia–Bell Arch was structurally high and formed a major barrier to the initial Ordovician (Canadian to Trentonian inclusive) seaways that transgressed into the southeast Arctic Platform from the north and northeast. Of importance also in the initial depositional phase of the Early and early Middle Ordovician, was the elevated and emergent northeastern segment of the Henrietta Maria–Transcontinental Arch that crossed the Boothia–Bell Arch in northern Quebec (Fig. 1), and continued across what is now central Hudson Strait and southern Baffin Island.

The initial Ordovician transgression apparently began in the late Early Ordovician (Canadian) in Foxe Basin, and possibly eastern Hudson Strait and Ungava Bay areas, and continued through Whiterockian to Chazyan(?) stages. If strata of those ages were deposited across the axis of the Henrietta Maria–Transcontinental Arch, they were removed by processes of erosion prior to the deposition of Trentonian-age strata, which overlap Canadian to Chazyan rocks and lie directly on Precambrian terrain across this major paleo-structural feature.

The second Ordovician marine invasion, also from the north and northeast, was during the late Blackriveran to early Trentonian (Rocklandian) stages. The limestones deposited during this period were of uniform composition and were

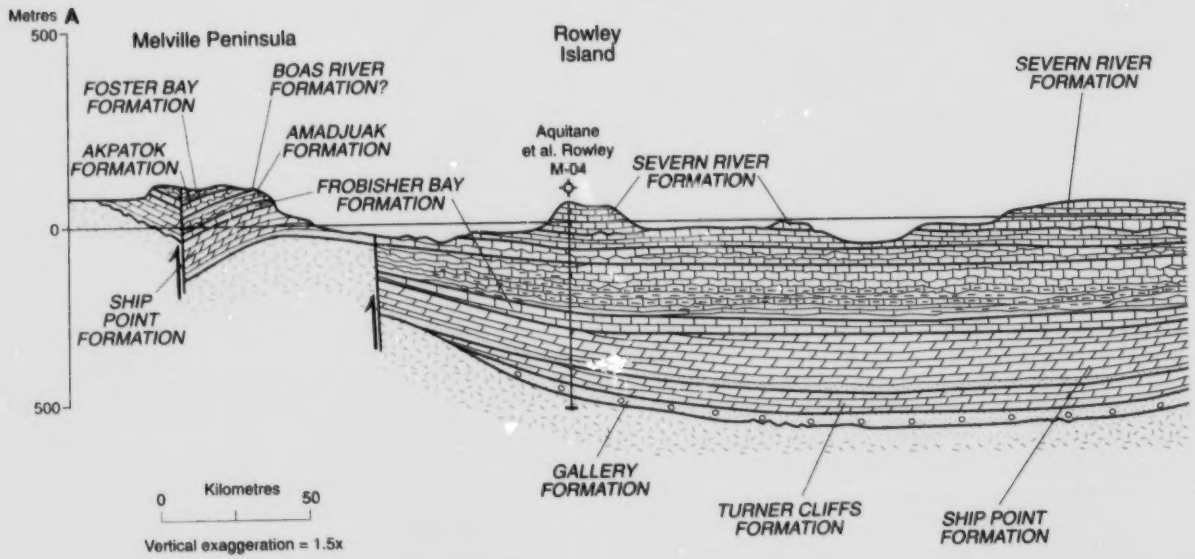


Figure 7. *Section A–A': eastern Melville Peninsula to southwest Baffin Island.*

widely distributed to the southwest, where they unconformably overlapped older strata and onlapped the structurally high Boothia–Bell Arch.

Following early Trentonian deposition and a hiatus, an early Edenian Ordovician sea again transgressed the southeast Arctic Platform from the north and northeast. Sedimentation was initially confined to the region northeast of Boothia–Bell Arch, but gradually spilled over the barrier into the Hudson Platform in the late mid-Edenian, a process that continued through Maysvillian and Richmondian stages. The rock units representing this Late Ordovician time interval in Hudson Strait, Ungava Bay, and Foxe Basin are lithologically very similar to equivalent strata mapped in Hudson Bay Basin (Heywood and Sanford, 1976; Sanford, 1987; Sanford and Grant, 1990). Some slight facies changes are thought to occur from place to place, as noted in Figure 4, but the significant differences are the greatly increased thicknesses of the late Maysvillian- and Richmondian-age strata that are recorded in the Ungava Bay–eastern Hudson Strait segment of the platform. One can only conclude that deposition in this area was near the edge of a continental shelf, in deeper open-marine conditions that were undergoing a more rapid rate of subsidence (Fig. 6).

STRATIGRAPHIC FRAMEWORK

The older Ordovician rock units (Canadian to Chazyan?) preserved in Foxe Basin and in the Ungava Bay region are lithologically dissimilar from one another and have thus been given separate names – Ship Point and Ungava Bay formations, respectively (Fig. 4) (Fig. 9 in pocket). Each of the succeeding units in both regions are sufficiently similar to be identified by the same terms; these are: the Frobisher Bay, Amadjuak, Boas River, Akpatok, and Foster Bay formations, in ascending stratigraphic order of succession.

The composite Ordovician succession showing the generalized lithological composition of rock units in Foxe Basin, Hudson Strait and Ungava Bay is contained in Figure 9. As a means of comparing the Ordovician succession in the southeast Arctic Platform to the Hudson Platform, a composite section for Southampton Island, as established by Sanford *in* Heywood and Sanford (1976), is shown in the same diagram.

Field investigations in Foxe Basin carried out on three different occasions were reconnaissance in scope, because of too few days of logistical (helicopter) support. On Melville Peninsula, some forty-eight sections were examined by B.V. Sanford and T.E. Bolton in 1973 (Sanford, 1977; Bolton, 1977), and on southern Baffin Island sixteen sections were examined by B.V. Sanford, A.C. Grant, and A.D. McCracken in 1988 (Sanford and Grant, 1990). McCracken and G.P. Martin visited most of these Baffin sections in 1989 (see McCracken, this volume). Information concerning the rocks exposed on Akpatok Island and beneath the waters of Ungava Bay and Hudson Strait was gleaned from a variety of sources, including Workum et al. (1976); rock samples collected from cliff sections on Akpatok Island courtesy of James Gray, University of Montreal; first-hand examination of the cuttings and cores from Premium Homestead Akpatok L-26 borehole and shallow cores in offshore regions of Hudson Strait and Ungava Bay; and from the interpretation of marine, high-resolution seismic data obtained by the Bedford Institute of Oceanography. The locations of the sections studied and

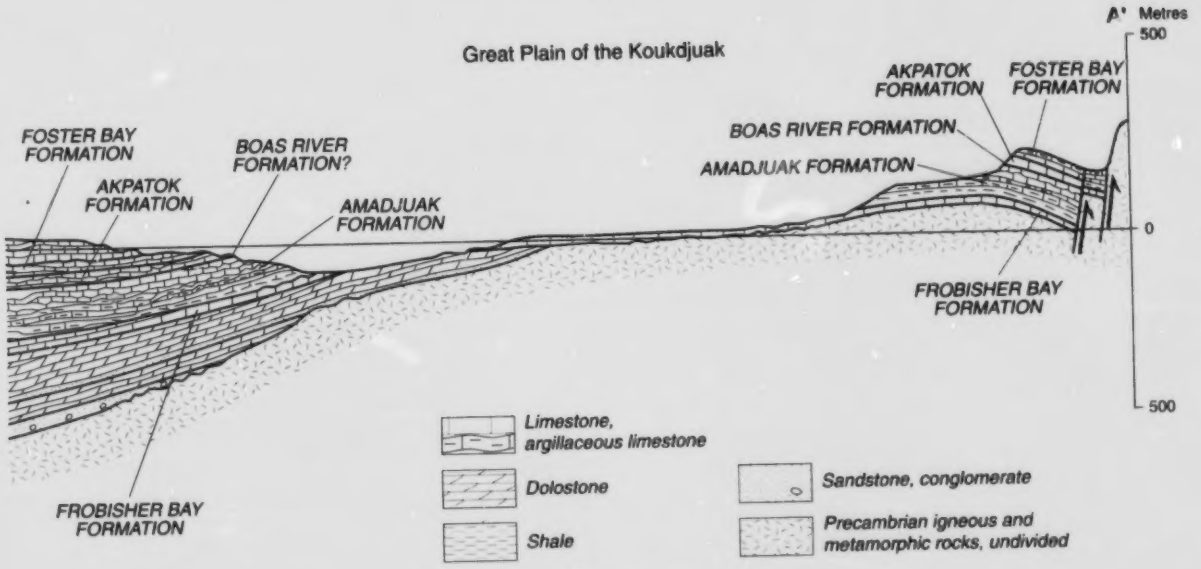


Figure 7. *Continued.*

other sources of data used in piecing together the Ordovician stratigraphic succession and the construction of a regional geological map are shown in Figures 2, 3, 5, 10–12.

Descriptions of the surface and subsurface sections examined on southern Baffin Island and Akpatok Island, including adjacent offshore are contained in Appendix 1.

In the central subsurface segment of Foxe Basin, Ordovician rocks have an estimated thickness of about 500 m (Fig. 7). They thin to 160 m on Melville Peninsula, and to 175 m on southern Baffin Island. Equivalent rocks beneath eastern Hudson Strait and Ungava Bay are substantially thicker. In the vicinity of Akpatok Island more than 585 m of Ordovician strata are known to be present, taking into consideration the combined strata encountered in the Premium Homestead Akpatok L-26 borehole (335 m) drilled on the west side of the island (Fig. 12), and the succeeding strata above the well site (250 m) that are exposed in the cliff sections rising above sea level. In addition, there may be 100 m or more of Ordovician strata beneath eastern Hudson Strait succeeding the youngest rocks exposed on Akpatok Island, making a total of about 685 m of Ordovician strata present in this extreme southeast segment of the Arctic Platform.

Ungava Bay Formation

The name Ungava Bay formation was informally proposed by Sanford and Grant (1990) to identify the Ordovician sandstones and minor carbonates and shales that lie directly on the Precambrian beneath Ungava Bay and eastern Hudson Strait. The term is used in the present text under the same definition, but is herein elevated to formal status.

The formation, nowhere exposed onshore, was completely penetrated by the Premium Homestead Akpatok L-26 borehole (60°25'40"N, 68°20'30"W), which is the type section, at a depth ranging from 172 to 354 m from the surface. Workum et al. (1976, fig. 3, appendix) provided lithological details from this borehole. Because of the friable character of the sandstone, only partial core recovery was achieved during the drilling process. In general, the formation consists predominantly of white to light grey, fine to medium grained orthoquartzitic sandstone, with quartz-pebble conglomerate about one metre thick at the base. Grey, shaly to silty dolostones and grey to white chalky fossiliferous limestones 32 m thick, with interbeds of grey, silty shale and shaly sandstone form a conspicuous unit 97 m above the base of the formation. A soft, sandy to silty, grey-green shale unit some 9 m thick is also present approximately 25 m below the top of the formation. The orthoquartzitic sandstones are loosely consolidated and porous, and may thus have originally contained a carbonate cement, the latter having been dissolved and removed by interstitial movement of meteoric and/or sea water.

The Ungava Bay Formation, some 182 m thick in the Premium Homestead Akpatok L-26 borehole, lies with abrupt and unconformable contact on deeply weathered Precambrian granite gneisses, and is disconformably succeeded by calcareous shales and shaly limestones of the Frobisher Bay Formation. Where the erosional edges of the sandstone unit form the bedrock surface on the seafloor beneath Ungava Bay and eastern Hudson Strait as

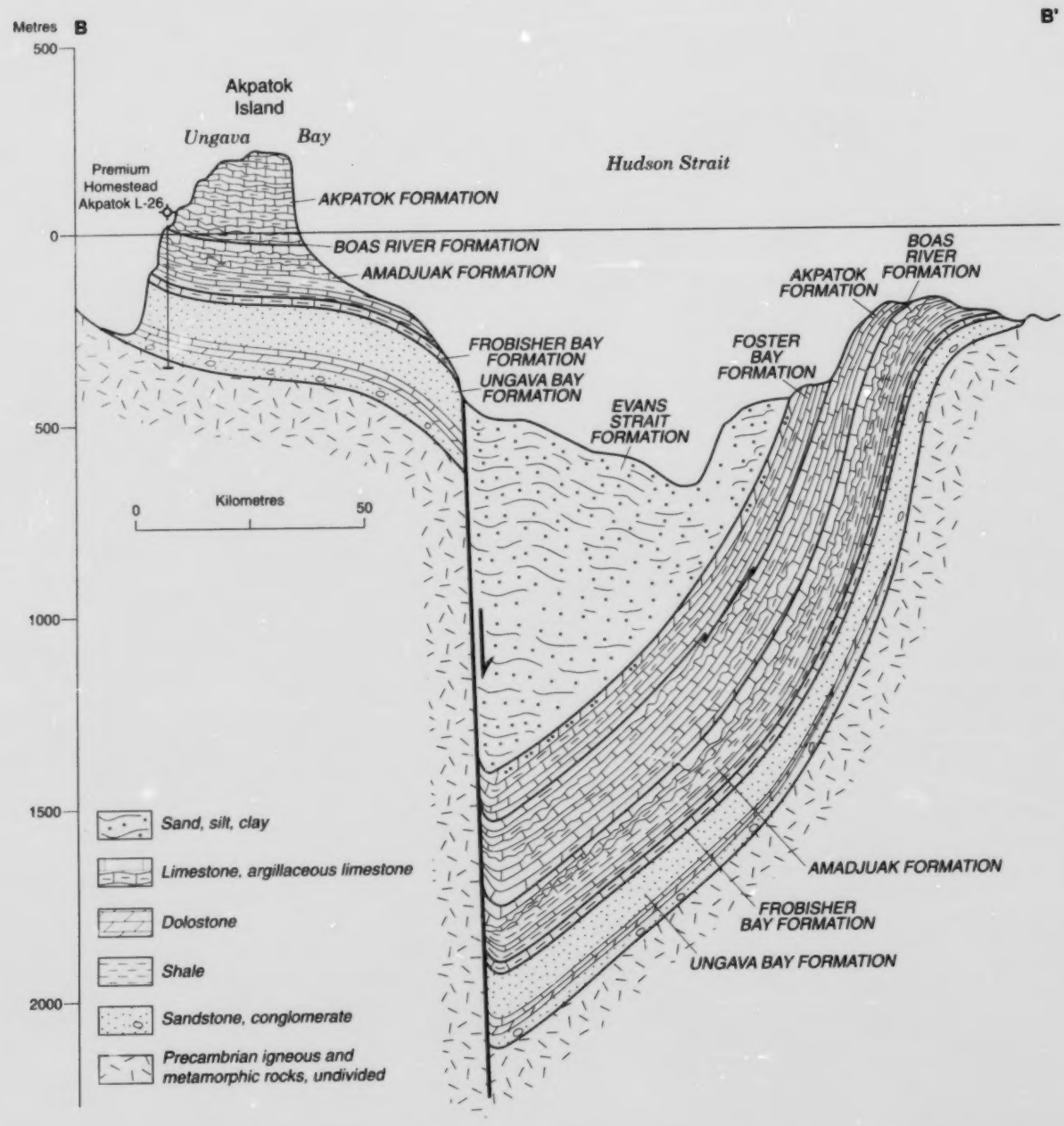


Figure 8. *Section B–B': Ungava Bay/Hudson Strait.*

determined by reflection seismic and bathymetric charts, they form an abrupt escarpment where succeeded by the more resistant Frobisher Bay and Amadjuak formations, as demonstrated in Figure 2 of Grant and Manchester (1970) and in Figure 5 of this present paper.

The carbonate strata contained within the lower part of the formation contain a conodont microfauna (Fauna 2 of Sweet et al., 1971) that indicates an early Middle Ordovician (Whiterockian) age (Barnes *in* Workum et al., 1976). Some of the lower beds of the formation could conceivably be of Early Ordovician (Canadian) age, and the upper beds as

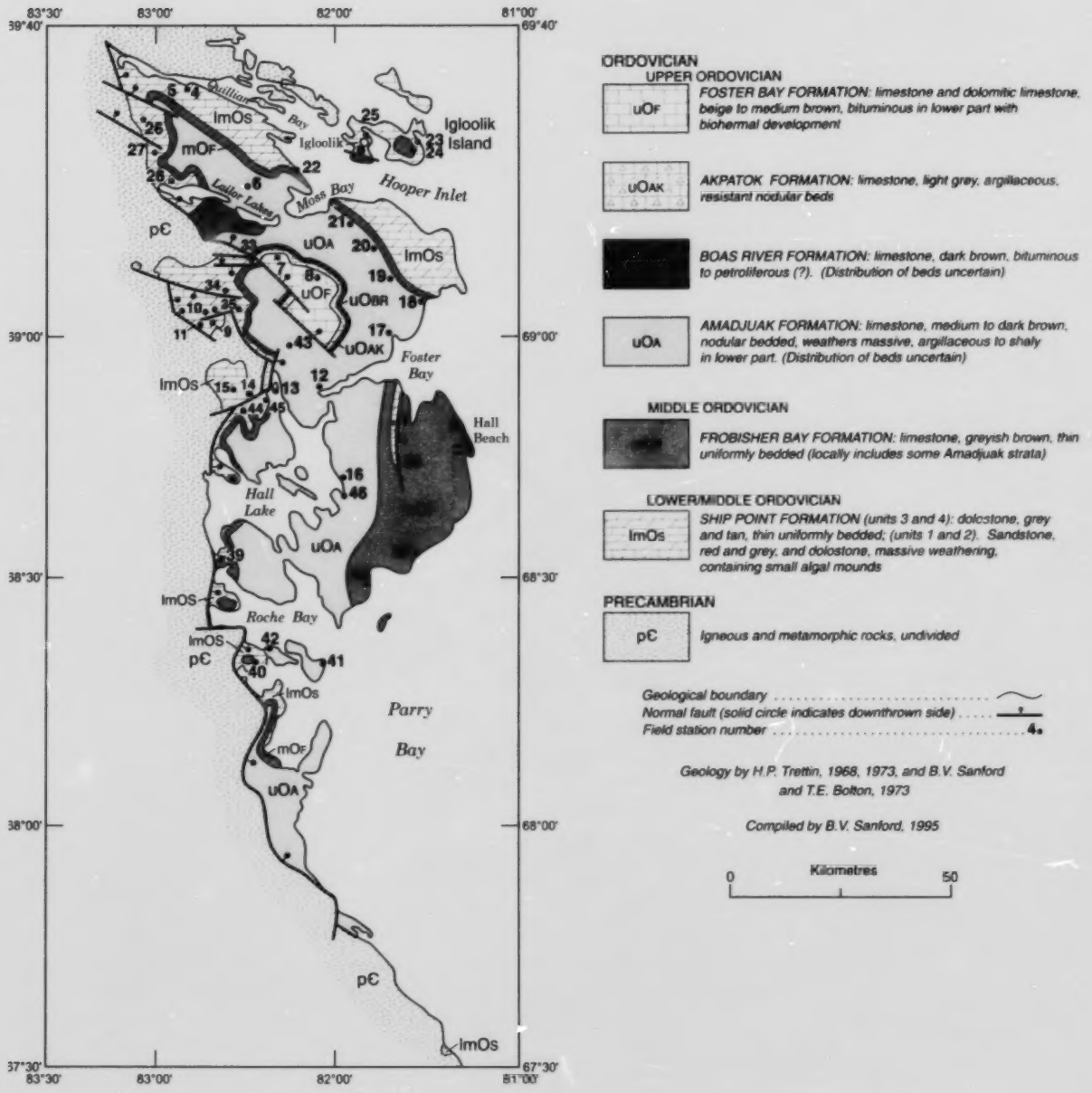


Figure 10. *Geology of eastern Melville Peninsula, Nunavut.*

young as Chazyan, making the strata roughly coeval to the Ship Point Formation of Foxe Basin.

The Ungava Bay Formation appears to be confined to Ungava Bay and eastern Hudson Strait, and its eroded edge beneath central Hudson Strait is disconformably overlapped by limestones of the Frobisher Bay Formation (Fig. 3). The Ungava Bay is also absent, either by processes of erosion or nondeposition, on southern Baffin Island, where limestones of the Frobisher Bay Formation can be observed to rest directly on the Precambrian.

Ship Point Formation

The oldest Ordovician rocks in Foxe Basin, unlike the coarse clastic facies of the Ungava Bay Formation, consist largely of carbonate rocks referred to the Ship Point Formation

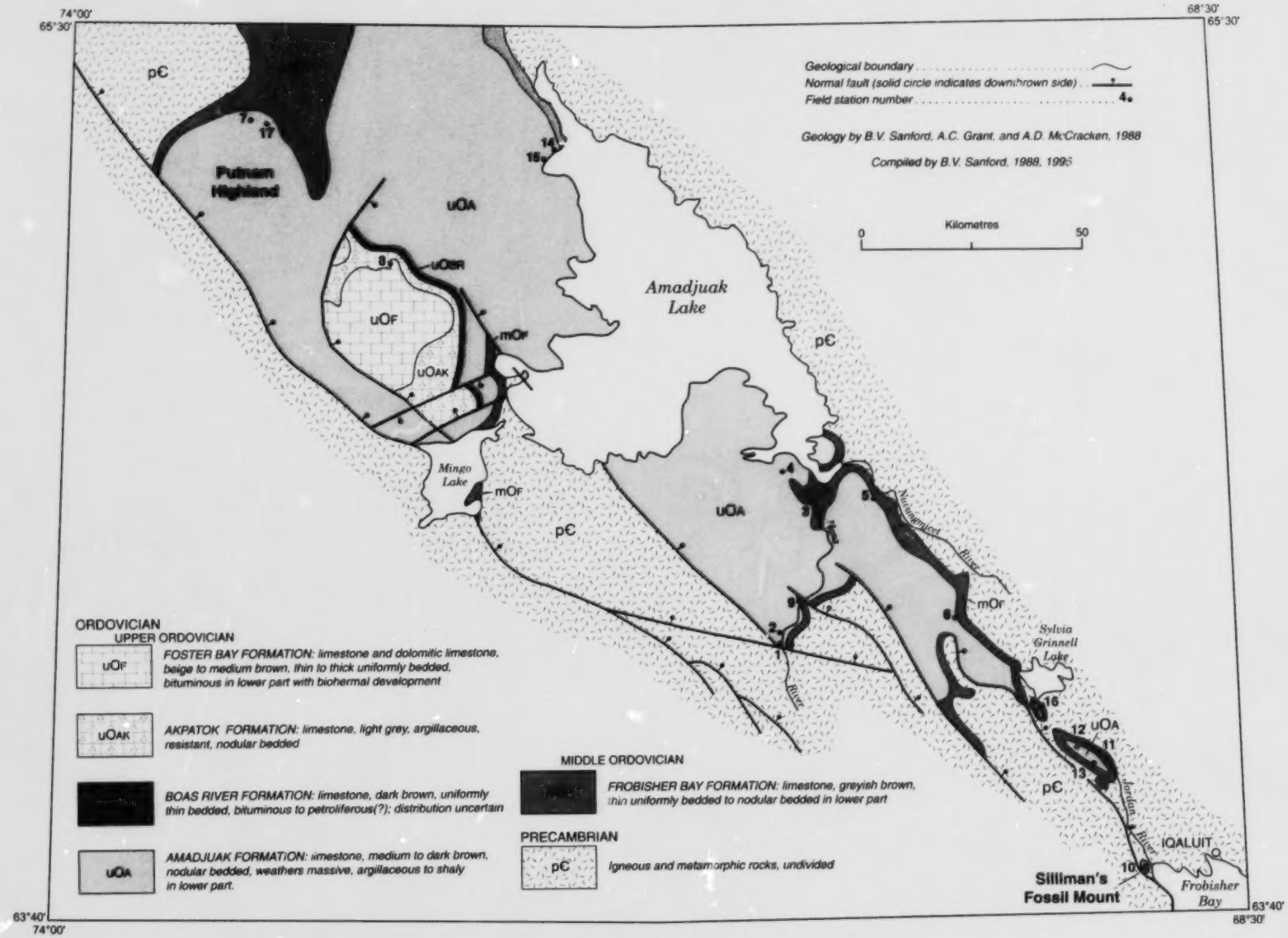
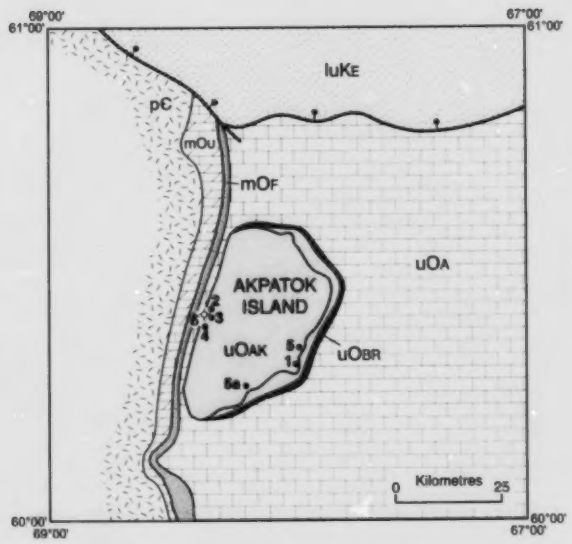


Figure 11. *Geology of Amadjuak Lake area, Baffin Island, Nunavut.*



Geological boundary

Normal fault (solid circle indicates downthrown side)

Field station number 4

Geology by I. Cox, 1993, and R.H. Workum, T.E. Bolton and C.R. Barnes, 1976

Compiled by B.V. Sanford and A.C. Grant, 1995

CRETACEOUS

LOWER/UPPER CRETACEOUS

luKE — *EVANS STRAIT FORMATION: sand, silt, and clay*

ORDOVICIAN

UPPER ORDOVICIAN

uOAK — *AKPATOK FORMATION: limestone, light to medium brown, argillaceous in part, weathers massive, thin to thick, nodular to uniformly bedded*

BOAS RIVER FORMATION: limestone, dark brown, uniformly thin bedded

uOA — *AMADJUAK FORMATION: limestone, medium to dark brown, with dark grey shale interbeds, weathers massive at top, thin nodular bedded*

MIDDLE ORDOVICIAN

mOF — *FROBISHER BAY FORMATION: limestone, greyish brown, argillaceous to shaly*

mOu — *UNGAVA BAY FORMATION: sandstone, white to light grey, with interbeds of sandy limestone and dolostone in lower part*

PRECAMBRIAN

pC — *Igneous and metamorphic rocks, undivided*

Figure 12. *Geology of Akpatok Island and adjacent offshore region, Nunavut.*

(Trettin, 1975). In the central part of the basin they rest with disconformable(?) contact on the Gallery and Turner Cliffs formations of Cambrian age, but overlap those units on the basin margins (i.e., Melville Peninsula and southern Baffin Island), to rest with abrupt and disconformable contact on Precambrian gneisses (Fig. 7). Ship Point strata are in turn succeeded disconformably by limestones and dolomitic limestones of the Frobisher Bay Formation.

On eastern Melville Peninsula, the Ship Point Formation, some 90 m thick, forms the bedrock surface for about 160 km along the Paleozoic–Precambrian boundary between Hooper Inlet and Parry Bay (Fig. 10), and is exposed at

Figure 13. *View down the Hone River toward Amadjuak Lake, southern Baffin Island. Cliff sections are composed of limestones of the Amadjuak Formation (GSC photo 1996-124K).*

Figure 14. *Raised beaches near Roche Bay, Melville Peninsula, section 41, GSC loc. 89869 (GSC photo 1996-124I).*

Figure 15. Akpatok Formation, looking north from Langley Creek, on the west coast of Akpatok Island (GSC photo 1996-124C).

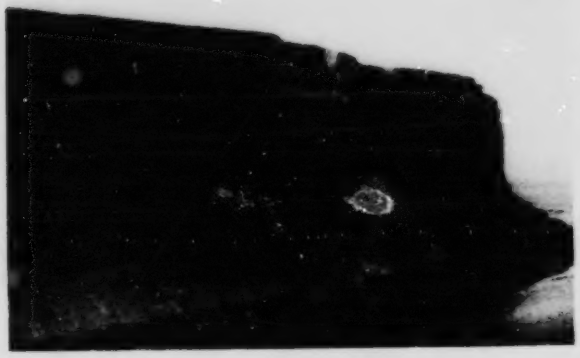


Figure 16. Akpatok Formation, 180 m high cliff section, southwest Akpatok Island (GSC photo 1996-124E).

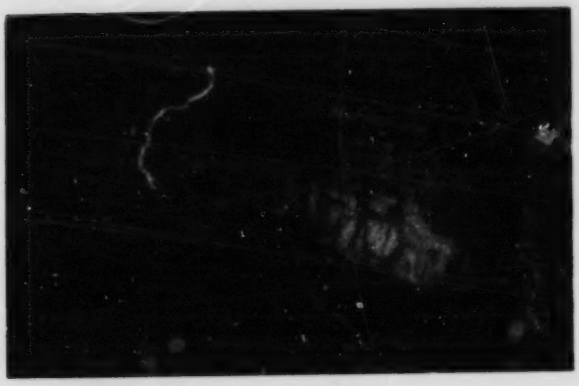


Figure 17. Akpatok Formation, looking southwest toward a 150 m high cliff section southwest of Umiak Cove, southeast Akpatok Island (GSC photo 1996-124F).

Figure 18. Algal mounds in lower carbonate beds of the Ship Point Formation, west of Hall Lake, Melville Peninsula, section 15, GSC loc. 89843 (GSC photo 202834-P).

numerous localities throughout this area. The most complete sections are at Roche Bay, Igloolik Island and Quilliam Bay. The latter locality displays a nearly complete section in a series of benches. Its distribution south of Parry Bay is not well known, but the formation presumably extends in the subsurface south of the outcrop belt, and is eventually overlapped by Frobisher Bay strata along the southern margins of Foxe Basin bordering Boothia–Bell Arch to the southwest. The formation in turn has a wide distribution eastward beneath Foxe Basin where it probably thickens to 120 m or more, but eventually pinches out to the southeast approaching the Great Plain of the Koukdjuak that forms the southwest shoreline of Baffin Island (Fig. 3). Remnants of Ship Point strata are present as outliers to the northwest of Foxe Basin, and eventually form a continuous bedrock terrain near the extreme northwestern end of Baffin Island.

B.V. Sanford and T.E. Bolton examined Ship Point sections at eighteen localities between Igloolik Island and Roche Bay (Sanford, 1977; Bolton, 1977); throughout this area the formation maintains a relatively uniform lithological character. Four distinctive units or members of informal status were identified, described in ascending order as follows:

- Unit 1, white, light grey, and salmon pink, medium- to coarse-grained, friable orthoquartzitic sandstone commonly containing a thin, basal, arkosic conglomerate resting directly and unconformably on Precambrian rocks. The sand grains are generally well rounded, commonly frosted and faceted, and were probably originally cemented by calcium carbonate, which has been removed by interstitial solution,

leaving the framework in its present largely unconsolidated state. The basal sandstone strata are about 12 m thick in the Quilliam Bay area, and appear to thicken slightly to the southwest toward the Boothia–Bell Arch, the probable source area of much of the detritus.

- Unit 2, gradationally succeeds unit 1, and consists of beige, medium grey and locally red, fine- to medium-crystalline and argillaceous dolostone in massive, resistant beds (up to 0.6 or 0.9 m) that weather orange and grey mottled. Many beds are laminated and contain an algal framework that locally swells into reef-like lenses or biohermal algal mounds (Fig. 18). The beds are generally sandy at the base with occasional sandy intervals throughout, contain sporadic flat pebble conglomerate, and are highly fucoidal at random horizons. Unit 2 varies in thickness from 7.5 to 16.5 m. A prominent stratigraphic break at the top of the unit may represent an erosional disconformity.

- Unit 3, the dominant lithology of the Ship Point Formation, some 60 m thick on Melville Peninsula. It is composed of light grey-tan and locally red microsucrosic dolostones that weather yellowish grey in beds 1.25 to 10 cm and locally to 18 cm in thickness. The beds are uniformly platy, laminated, evenly bedded, and commonly contain stromatolites, fucoidal horizons, well developed ripple markings, intraformational breccias, and flat pebble conglomerate at random intervals throughout the unit (Fig. 19). Unit 3 also contains sporadic sandstone, sandy dolostone, and red and grey-green shale interbeds, confined mainly to the lower part of the unit.

- Unit 4, light grey-beige and orange mottled algal and vuggy dolostone that weathers yellowish orange and grey mottled (Fig. 20). The beds (7.5 to 15 cm) are hard – more resistant and massive weathering than the underlying strata of unit 3 – and therefore tend to form low escarpments on the landscape. The thickness is highly variable, possibly because of erosion immediately following its deposition, ranging from barely a veneer to 7.5 m or more.

The age of units 1 and 2 of the Ship Point Formation is uncertain, but quite possibly Early Ordovician (Canadian), based on their stratigraphic position beneath known early Middle Ordovician (Whiterockian) strata. On the basis of conodonts (Faunas 2 and 4 of Sweet et al., 1971), Barnes (1977) has placed the bulk of the Ship Point (units 3 and 4) in the early Middle Ordovician Whiterockian to Porterfieldian (Chazyan?) stages. The presence of conodont Fauna 2 in Ship Point strata thus confirms a partial correlation, at least, of the formation with the carbonate beds in the lower part of the Ungava Bay Formation beneath A'cpatok Island. No diagnostic megafossils were found in the sections examined.

Frobisher Bay Formation

The informal name Frobisher Bay formation was proposed by Sanford and Grant (1990) to replace unit 1 of the Bad Cache Rapids Formation, the latter a term used by Sanford (1977) to identify some 15 m of strata overlying the Ship Point Formation on Melville Peninsula. As these rocks are now known to be lithologically and faunally distinct from the somewhat younger Bad Cache Rapids Group as defined in the Hudson Platform, the latter designation is no longer

Figure 19. *Thin laminated beds of the Ship Point Formation, near Roche Bay, Melville Peninsula, section 40, GSC loc. 89868 (GSC photo 202834-Y).*

Figure 20. *Frobisher Bay dolomitic limestones resting disconformably on Ship Point dolostones near Quilliam Bay, Melville Peninsula, section 5, GSC loc. 89833 (GSC photo 202834-Z).*

considered valid for this region and the term Frobisher Bay Formation, raised to formal status, is herein applied in its stead.

The beds are present throughout the southeast Arctic Platform, and are well exposed at a number of localities around the margins of Foxe Basin, particularly on Melville Peninsula and southern Baffin Island (Fig. 3). The Frobisher Bay Formation is nowhere exposed in the Ungava Bay, Hudson Strait, and Foxe Channel segments of the platform, but is identified in the Premium Homestead Akpatok L-26 borehole at 172 to 146 m below the surface, and is recognizable on high-resolution marine seismic profiles where the beds are present on the seafloor around the margins of the Paleozoic (Ordovician) erosional remnants. The 26 m of Frobisher Bay Formation that are contained in the Premium Homestead Akpatok L-26 borehole consist of grey, calcareous shales with limestone interbeds 7.6 m thick succeeded by 18.4 m of light grey, uniformly bedded, argillaceous limestone with grey-green shale partings (Fig. 9). In Ungava Bay and eastern Hudson Strait area, the formation lies with abrupt and disconformable contact on sandstones of the Ungava Bay Formation, and is in turn overlain with probable disconformable contact by shales and limestones of the Amadjuak Formation. From there, the Frobisher Bay stratigraphically overlaps the Ungava Bay Formation to lie directly on the Precambrian through central and western Hudson Strait and beneath Foxe Channel.

In Foxe Basin, the Frobisher Bay Formation disconformably succeeds the Ship Point Formation (Fig. 20), but overlaps the latter in southern Baffin Island to lie unconformably on the Precambrian (Fig. 21). Perhaps the more accessible outcrops of the Frobisher Bay Formation are on southern Baffin Island. These are in a large outlier along the Jordan River, some 25 km above its mouth on Frobisher Bay at 63°59'15"N, 69°10'00"W, and in a small outlier near the south shore of Sylvia Grinnell Lake at 64°05'45"N, 69°26'45"W (sections 11 and 16, respectively; Fig. 11).

At the Jordan River locality, 5 m of strata are exposed in a narrow gorge of the river where it flows across the eastern margin of a southeast-oriented Ordovician outlier (Fig. 22). Here, the beds consist of grey and light brown, microcrystalline limestone and dolomitic limestone that weathers light grey with minor yellowish orange mottling.

At Sylvia Grinnell Lake, 15 m of Frobisher Bay strata are present where a small stream crosses the outlier, and this exposure is selected as the type section of the formation. The lower beds (8 m thick) resting with unconformable contact on Precambrian metamorphic rocks, consist of light grey and light brown, finely crystalline limestone in thin nodular beds that weather yellowish orange. These are succeeded by light grey, finely crystalline limestones (7 m thick) in uniform beds (5–10 cm) that weather medium grey. The upper, more evenly bedded rocks are hard, massive weathering and thus more resistant to erosion than the underlying strata.

The Frobisher Bay Formation was examined at only four stations on Baffin Island (Nos. 11, 16, 3, 9, Fig. 11), but good exposures of the formation are present elsewhere on southern Baffin Island along the Hone River, possibly the lower reaches of the Nuvungmiut River, and on unnamed streams flowing off and adjacent to Putnam Highland. Complete sections of the Frobisher Bay Formation were not found on Baffin Island, but 15 m as measured at Sylvia Grinnell Lake is probably a fair estimate of its maximum thickness in this segment of Foxe Basin.

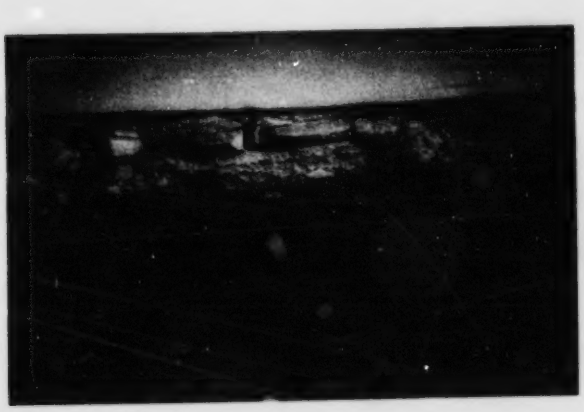


Figure 21. *Contact between the Frobisher Bay Formation and the Precambrian, near mouth of Hone River, Baffin Island, section 3, GSC loc. O-104190 (GSC photo 1996-124G).*

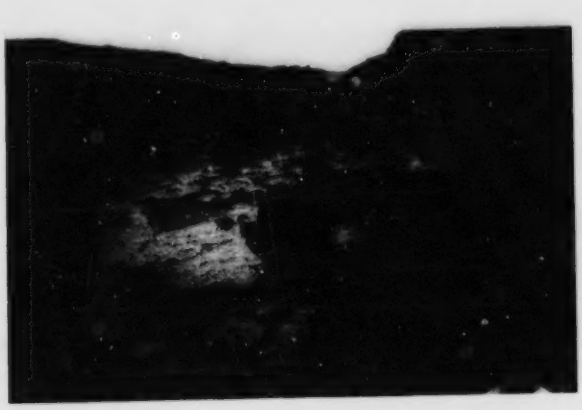


Figure 22. *Frobisher Bay Formation, Jordan River, Baffin Island, section 11, GSC loc. 0-104199 (GSC photo 1996-124H).*

Eight sections of Frobisher Bay strata were examined by Sanford and Bolton on Melville Peninsula in 1973 (Sanford, 1977; Fig. 10), in the region extending from Igloolik Island to the vicinity of Roche Bay. Here, the beds, some 15 m thick, consist of light brown, microcrystalline dolomitic limestone at the base, grading upward to limestone that weathers light grey with minor yellowish orange mottling (Fig. 23). The beds are assumed to be continuous in the subsurface between Melville Peninsula and southern Baffin Island, but probably thicken substantially in the central part of Foxe Basin, as is speculated in Figure 7.

Perhaps one of the best exposures of the Frobisher Bay Formation in Foxe Basin with both lower and upper contacts exposed can be seen in a northeast-facing escarpment 6.4 km south of Quilliam Bay on Melville Peninsula at 69°27'25"N, 82°51'45"W (Sanford, 1977, Section 5, fig. 10, 11). Here the formation, 15 m thick, rests with abrupt and disconformable contact on thin, platy dolostone beds of the Ship Point Formation (Fig. 20), and is in turn overlain with sharp contact by the highly irregular, nodular shaly limestones of the Amadjuak Formation. The Ship Point–Frobisher Bay contact is placed at 28 m above the base of the escarpment. Where the Frobisher Bay strata overlie the somewhat less resistant dolostones of the Ship Point Formation in Melville Peninsula, their erosional edge is commonly marked by a major escarpment, and beyond the erosional boundary, remnants of the Frobisher Bay and upper Ship Point strata locally rise vertically above the lowland to form conspicuous buttes.

The beds shown in Figures 22 and 23, and elsewhere in Foxe Basin, contain a distinctive *Gonioceras–Labyrinthites* sponge megafauna assemblage (Bolton, 1977 and this volume) that indicates a late Middle Ordovician (Blackriveran–early Trentonian) age (Fig. 4). On the basis of its contained conodont microfauna (particularly the presence of *Polyplacognathus ramosus* Stauffer), McCracken (this volume) favours the younger designation (early Trentonian, Rocklandian) as a possible age for the Frobisher Bay Formation.

Figure 23. *Lower, uniformly bedded limestones of the Frobisher Bay Formation, south of Lailor Lakes, Melville Peninsula, section 29, GSC loc. 89857 (GSC photo 202834-L).*

Amadjuak Formation

The Amadjuak formation was informally proposed by Sanford and Grant (1990) for the limestones, shaly limestones and shales that disconformably succeed the Frobisher Bay Formation in Foxe Basin and adjacent areas of Ungava Bay, Hudson Strait and Foxe Channel. That name, herein raised to formal status, is perhaps the most appropriate in light of the well exposed sections displayed on the northwest shore of Amadjuak Lake at 65°14'50"N, 71°41'00"W and at 65°14'25"N, 71°41'25"W (sections 14 and 15 respectively, Fig. 11, 24, 25). Rocks of the same age and older (Amadjuak and Frobisher Bay formations) were

Figure 24. *Limestones and shales of the Amadjuak Formation, northwest shore of Amadjuak Lake, Baffin Island, section 14, GSC loc. 0-104202 (GSC photo 1996-124J).*

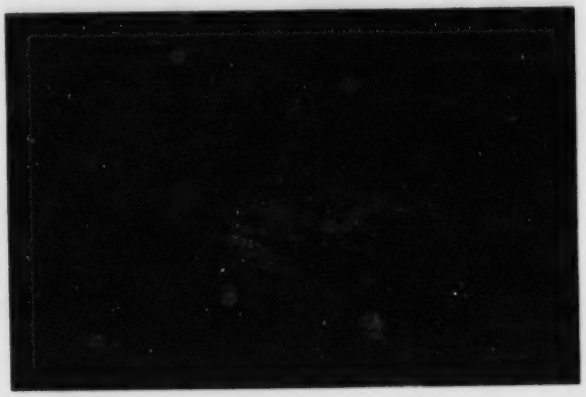


Figure 25. *Upper beds of the Amadjuak Formation, small stream gorge on the northwest shore of Amadjuak Lake, Baffin Island, section 15, GSC loc. O-104207 (GSC photo 1996-124B).*

briefly referred to Putnam Highland Formation by Gould (1928) but so far as is known, the term was never clearly defined or used by subsequent workers.

The most accessible strata of the Amadjuak Formation occur at Silliman's Fossil Mount (section 10), a small, isolated, Paleozoic outlier, located 23 km due west of Iqaluit (63°45'00"N, 68°56'45"W). This exposure is selected as the type section (Fig. 26). Here the beds are some 71 m thick, and represent a nearly complete sequence of the Amadjuak Formation, comprising the following units 1 to 3, in ascending order:

- Unit 1 (21 m thick), consisting of interbedded, medium to dark grey and black shale and grey to grey-brown shaly limestone in thin, uniform beds. The lower contact with the immediately underlying Frobisher Bay Formation is gravel covered, but the vertical and horizontal configuration of the latter (12 m thick) can be readily seen in profile because of its hard, resistant weathering character.

- Unit 2 (approximately 34 m thick), beginning with hard, resistant weathering, medium grey-brown limetone (2 m), in thick massive beds, abruptly succeeded by medium grey, thin and nodular bedded shaly limestone and grey interbedded shales (21 m) that are recessively weathered and partly talus covered. This is followed by slightly more massive, nodular, argillaceous grey limestone with minor shale partings and interbeds (11 m).

- Unit 3 (approximately 16 m thick), caps unit 2, and consists of hard, light to medium brown, nodular bedded, massive weathering limestones with distinctive light yellowish orange discoloration.

In addition to exposures at Silliman's Fossil Mount, and those at Amadjuak Lake, the formation is well exposed elsewhere on southern Baffin Island, notably at Putnam Highland (Fig. 27), on the west shore of Nettilling Lake, at several localities along the Hone River, and in outliers south of Sylvia Grinnell Lake. In this segment of Foxe Basin the beds are up to 100 m thick, and are divisible into three units or members of informal status, in ascending order:

- Unit 1 (20–28 m thick), at the base, lying disconformably on the Frobisher Bay Formation, and comprising uniform to nodular bedded, light grey to dark brown argillaceous limestone and interbedded medium to dark grey shale and locally, black, petroliferous shales.

- Unit 2 (20–40 m thick), comprising nodular, flaggy and rubbly weathering, thin bedded argillaceous limestone with minor shale interbeds.

- Unit 3 (28–35 m thick), comprising massive, resistant weathering, light to medium brown, nodular bedded limestones and dolomitic limestones that wherever present form an abrupt and conspicuous escarpment on the landscape.

All of the strata, and particularly those of units 2 and 3, weather to a characteristic mottled grey and yellowish orange. The nature of the contact of the Amadjuak with the overlying Boas River Formation (if the latter is anywhere present in Foxe Basin), is unknown, but assumed to be

Figure 26. *Amadjuak Formation at Silliman's Fossil Mount, head of Frobisher Bay, Baffin Island, section 10, GSC loc. 0-104198 (GSC photo 1996-124D).*

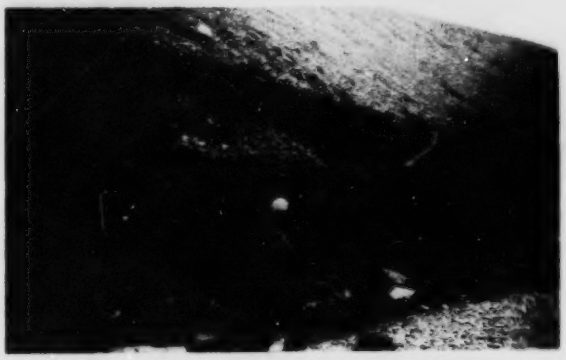


Figure 27. *Limestones and minor shales of the Amadjuak Formation, Putnam Highland, Baffin Island, section 7, GSC loc. 0-104194 (GSC photo 1996-124-A).*

conformable and gradational, as is elsewhere reported in the Ungava Bay region and Hudson Bay Basin (Sanford and Grant, 1990). Because of the recessive weathering character of the Boas River Formation however, the contact may not be exposed anywhere in this region of the southeast Arctic Platform.

The southern Baffin Island area was visited briefly in 1986 by N.J. McMillan and G. Macauley of the Geological Survey of Canada. An important outcome of their investigation was the identification of bituminous and "oil shale" deposits within the Ordovician succession and recognition of their hydrocarbon source rock potential (Macauley, 1987; Macauley et al., 1990, p. 12-15). These deposits occur within the lower, thin, argillaceous to shaly beds of the Amadjuak Formation, the best occurrence reported being confined to a cliff section of a large, Paleozoic outlier located immediately west of the Jordan River (section 11; Fig. 11), approximately 30 km above its mouth. Similar beds, but with lesser organic content, were identified by Macauley (1987) elsewhere on southern Baffin Island, including exposures immediately west of Nuvungmiut River, and on the northwest shore of Amadjuak Lake.

Limestones and shales of the Amadjuak Formation on southern Baffin Island are now merely remnants of their former distribution, but have wide surface and subsurface distribution to the west in Foxe Basin proper (Fig. 3, 7). They are well exposed on Melville Peninsula at many localities over the some 160 km between Igloolik Island and Roche Bay, with the most complete sections being located near Quilliam and Roche bays (Fig. 10, 28). Throughout this region, the formation, about 20 m thick, consists of light to medium brown microcrystalline algal limestones with thin shale interbeds and partings more common near the base, all in thin uneven, nodular beds from 0.5 to 1.25 cm thick, which weather grey and mottled rusty-orange.

Unit 1 strata of the Amadjuak Formation, recognized elsewhere in Foxe Basin (i.e., southern Baffin Island) are absent on Melville Peninsula (Fig. 9), and only partial sequences of units 2 and 3 appear to be represented in this western segment of the platform. One possible explanation for the absence of unit 1 and significant thinning of the Amadjuak Formation in general in this particular region is the presence of the northeast-trending Keewatin Arch that crosses Melville Peninsula, a major tectonic feature (Fig. 1) that was known to be active in the Paleozoic and possibly later (Mesozoic/Tertiary?) times (Sanford, 1987; Sanford and Grant, 1990). The absence of lower Amadjuak strata (Unit 1) in Melville Peninsula, and thinning of units 2 and 3 suggest that this segment of the arch was uplifted and temporarily emergent immediately following deposition of the Frobisher Bay Formation. It apparently remained a relatively stable and positive element, although submergent, throughout much of the remainder of Ordovician time.

The Amadjuak Formation forms the bedrock surface on the west shore of Akpatok Island (Fig. 12) in Ungava Bay, and its general lithology and thickness of 123.1 m (Fig. 9) was determined from cuttings sample from the Premium Homestead Akpatok L-26 borehole at depths of 22.9 to 146.0 m from the surface. A three-fold subdivision of the formation at this locality, similar to Foxe Basin, was established and tied into the offshore seismic network as follows, in ascending order:

- Unit 1 (60.6 m thick), greyish green to grey and brown shale, with grey, shaly limestone interbeds (18.3 m thick) in the upper part of the lower half of the unit. The shale at the base of Unit 1 is in sharp and possible disconformable contact with the shaly limestone of the underlying Frobisher Bay Formation.

- Unit 2 (48.8 m thick), alternating brown limestone and bituminous shale.

- Unit 3 (13.7 m thick), hard, light to dark brown, microcrystalline limestones. These beds rise from beneath the waters of Ungava Bay to an elevation of 4.6 m above mean high-tide sea level on the west shore of Akpatok Island, where they are gradationally succeeded by brown, bituminous limestones of the Boas River Formation.

The Amadjuak Formation contains a distinctive *Fisherites* and *Maclurites* fauna, along with several coral and cephalopod genera that relate these beds to the "Arctic Ordovician Red River" fauna (Bolton, 1977 and this volume). The upper half of the formation (units 2 and 3) is roughly equivalent to the Bad Cache Rapids Group of Southampton Island and Hudson Bay lowlands, and on the basis of their contained megafauna and conodont microfauna (McCracken and Nowlan, 1989), are of Late Ordovician Edenian to mid-Maysvillian age (Fig. 4).

Figure 28. *Upper, irregularly bedded limestones of the Amadjuak Formation on the island in the north end of Hall Lake, Melville Peninsula, section 13, GSC loc. 89841 (GSC photo 202834-R).*

Boas River Formation

The Boas River Formation, an "oil shale" unit on Southampton Island in Hudson Bay, was originally identified and named by Sanford *in* Heywood and Sanford (1976). So far as is known, it outcrops at only one location on the island, in a steam-cut of the Boas River, approximately 3.2 km south of the Paleozoic–Precambrian boundary (GSC loc. 84606; 64°20'45"N, 84°40'25"W). At this location, the type section, 1.5–2.1 m of thin, uniformly bedded black calcareous and petroliferous shales overlie the dark brown limestones of the Bad Cache Rapids Group with gradational contact. The upper contact of the Boas River with limestones of the Churchill River Group was nowhere observed by Heywood and Sanford (ibid.) in their investigations of Southampton Island. More recent investigations by Sanford (1987) and Sanford and Grant (1990) have established wide distribution of the Boas River Formation in the Hudson Bay Basin, where it is conformable and gradational with the underlying Bad Cache Rapids Group, as well as the succeeding Churchill River Group.

The presence of Boas River strata beyond the margins of Hudson Bay Basin, on Akpatok Island in Ungava Bay, was established by Bolton *in* Workum et al. (1976) on the basis of the lithology of the rocks and their contained megafauna. The section measured and collected by Workum is located immediately to the east of the Premium Homestead Akpatok L-26 borehole (60°25'40"N, 68°20'30"W). Here, the brown, bituminous limestone of the Boas River Formation, some 4.5 m thick, can be seen to rest directly on the hard, resistant weathering limestones of the Amadjuak Formation, the contact being placed 4.6 m above mean high-tide sea level. The upper contact of the Boas River with the succeeding Akpatok Formation, also gradational and conformable, is placed at 9.1 m above the high-tide sea level. The distribution of the Boas River in the offshore immediately to the east of Akpatok Island and beneath eastern Hudson Strait is based on high-resolution seismic interpretation and bathymetric configuration of the seafloor (Fig. 7, 12).

According to Bolton *in* Workum et al. (1976), the brown bituminous limestone, exposed on Akpatok Island, contains a *Leptobolus – Triarthrus – Pseudogygites – Geisonoceras* fauna characteristic of Ordovician shales and limestones throughout eastern Canada – the Boas River oil shale of Southampton Island, and the Collingwood (Whitby Formation) shale and limestone of southern Ontario – all of which are now considered to be of Late Ordovician, middle to late Maysvillian age (Fig. 4).

Because of its recessive weathering character, the Boas River Formation may not be exposed in Foxe Basin, and its distribution and thickness are thus largely unknown. Many fragments of Boas River shale were found and collected along the shore at Cape Donovan by B.V. Sanford during reconnaissance mapping of Southampton Island in 1969. The formation is thus thought to be present in Foxe Basin, but its possible distribution, as shown in Figures 3 and 6, is conjectural and approximate.

Akpatok Formation

The name Akpatok formation was informally proposed by Sanford and Grant (1990) for the succession of strata exposed in the cliff sections of Akpatok Island in Ungava Bay (Fig. 15–17), and that term is raised to formal status in the present paper. It applies to the 240+ m of limestone and minor shale that underlie a large segment of eastern Hudson Strait (Fig. 7, 8), and conformably succeed the Boas River Formation, rising abruptly to form the promontory of Akpatok Island. In the Sanford and Grant (ibid.) paper, the sequence exposed on Akpatok Island was thought to comprise the youngest Ordovician strata represented in the Ungava Bay–eastern Hudson Strait region, but younger beds above the Akpatok Formation have now been recognized by the writers in the latter area. These younger beds are herein correlated with the Foster Bay Formation of Foxe Basin, and identified by that term in the present text.

Rock samples collected in 1989 at Gregson Creek (Fig. 12) by James Gray, University of Montreal, provide a good representation of the rocks exposed on Akpatok Island from sea level to an elevation of 78 m above sea level (Fig. 9). Some of the lower samples are representative of the Amadjuak Formation (discussed in previous section), but the samples collected from about 10 m above high-tide mark to 78 m consist of medium brown, micritic limestone with minor shale partings in uneven beds of 5 to 10 cm, with grey and yellowish orange mottled weathering. The lower contact of the Akpatok Formation with the underlying Boas River Formation, which is conformable and gradational, is placed at 9.1 m above mean high-tide sea level. The beds have a fair degree of lithological similarity to the Upper Ordovician (late Maysvillian to Richmondian) Churchill River Group of Southampton and Coats islands (Fig. 3, 9), and are considered roughly equivalent.

The Akpatok Formation has wide distribution in Foxe Basin (Fig. 3), but was not identified by Sanford (1977) and Bolton (1977) on Melville Peninsula. It is thought to be present in the Foster Bay area although now obscured by Quaternary deposits. The formation was identified at a single locality on southern Baffin Island in a stream-cut (GSC loc. 0-104195, 65°01'45"N, 72°27'55"W) immediately to the southwest of Amadjuak Lake (Fig. 11, section 8; Fig. 29). Here are exposed approximately 9 m of the formation, consisting of light grey argillaceous limestone in resistant nodular beds 5 to 7.5 cm thick that weather medium to dark grey. The upper boundary of the Akpatok Formation is exposed at this locality 9 m above the base of the outcrop.

Figure 29. *Limestones of the Akpatok Formation exposed in stream-cut southwest of Amadjuak Lake, Baffin Island, section 8, GSC loc. 0-104195 (GSC photo 1996-124L).*

The contact of the hard, resistant limestones of the Akpatok with the overlying, platy beds of the Foster Bay Formation is sharp, but probably conformable.

Only a few megafossils were collected at this locality, which according to Bolton (this volume) were indeterminate, but favoured a late Late Ordovician age. Conodont samples collected by A.D. McCracken (this volume) yielded an *ordovicicus* Zone microfauna, which places the beds present at this locality within the Late Ordovician Maysvillian to Richmondian stages.

Foster Bay Formation

Foster Bay formation was informally introduced by Sanford and Grant (1990) for the succession of Upper Ordovician limestones and dolomitic limestones and associated reefs succeeding the Amadjuak Formation in Foxe Basin. Since publication of their paper, the presence of the Akpatok Formation in the Foxe Basin has been firmly established and the definition of the Foster Bay is thus amended to include only the youngest Ordovician strata succeeding that formation (Fig. 9).

Although the beds appear to have a wide distribution around the margins of Foxe Basin, and in the subsurface beneath younger rocks of Early Silurian (Llandovery) age in the central basin area, details of their lithology and thickness are as yet poorly known. They are present in southern Baffin Island as an isolated remnant located a short distance southwest of Amadjuak Lake (section 8; Fig. 3) where they are largely obscured by frost-heaved blocks and limestone fragments that were presumably sorted and deposited as gravels during recession of the Tyrrell Sea. From the few beds that appeared to be in place lying with abrupt contact on the Akpatok Formation, and loose blocks scattered around the outcrop belt, the formation can be described as essentially consisting of medium brown, bituminous limestone in thin laminated and platy uniform beds that weather light grey-beige in colour. Some of the beds slightly higher in the section, consisting of light brown to beige, finely crystalline, dolomitic limestone in thin, uniformly bedded strata, contain a profusion of small algal masses. The presence of the latter suggests that the Foster Bay Formation may be reefal in character in this eastern segment of the basin, as it is reported to be elsewhere in Foxe Basin (Sanford, 1977; Trettin, 1975).

The Foster Bay Formation is best exposed on the west side of Foxe Basin, also as an isolated remnant in a downfaulted block (half-graben) on Melville Peninsula between Foster and Mogg bays, some 15 km west of Foster Bay, and that area (Fig. 10) is selected as the type locality (GSC loc. 89835; 69°10'02"N, 82°15'05"W; section 405c of Trettin, 1975, section 7 of Sanford, 1977). The beds here are composed principally of thin and thick bedded (1.25–30 cm), sucrosic textured, brownish-beige limestones that weather yellowish grey and grey mottled. They are mostly flat lying, but locally dip at 5–10° where they form the off-reef carbonate detritus of a nearby bioherm.

Contained within the Foster Bay carbonates on Melville Peninsula are many pinnacle reefs 0.8 km in diameter that rise as klintar up to 30 m above the floor of the lowland (Fig. 30). The reef cores, exhibiting central atoll-like depressions at their summits, consist primarily of light to medium brown algal and stromatolitic limestone framework. They are very similar to Red Head Rapids Formation reefs mapped on Southampton Island (Heywood and Sanford, 1976), except that in eastern Melville Peninsula more open-marine conditions existed during their growth, and this was thus conducive to the proliferation of corals and other marine organisms.

Figure 30. *Core of a bioherm, composed mostly of algal framework, Foster Bay Formation, Melville Peninsula, GSC loc. 89835 (GSC photo 202834-S).*

The paleofavositid corals and other fossils of the Foster Bay reef cores and conodonts from the inter-reefal beds are classified as Late Ordovician (Bolton, 1977, p. 27). Barnes (1974, p. 235) also assigned a Late Ordovician date to the lithologically similar Red Head Rapids reef-bearing strata of Southampton Island.

The remnants of Foster Bay strata on southern Baffin Island, although very poorly exposed, may reach a thickness of 45 m or more, and only a thin veneer of 15 m or less is likely present in Melville Peninsula. A thickness of 50 m in central Foxe Basin is an estimate only, and may greatly exceed that number, where preserved beneath strata of the Severn River Formation (Fig. 3, 7).

The term Foster Bay Formation is also herein applied to the eastern segment of Hudson Strait to identify the highest Ordovician beds that overlie the Akpatok Formation and which in turn are overlain unconformably by shales and sandstones of Cretaceous age, the Evans Strait Formation. The thin, evenly bedded strata of the Foster Bay Formation in this offshore region, 100 m or more thick, have good acoustic penetration, and are well displayed on high-resolution marine seismic profiles. As in the Foster Bay Formation of Melville Peninsula, and the Red Head Rapids of Southampton Island, the rocks in eastern Hudson Strait contain a progression of highly irregular mounds that suggest the possible presence of pinnacle reef development in this offshore region.

Four shallow cores (Fig. 3) were obtained from the Foster Bay Formation in eastern Hudson Strait by B. MacLean of the Bedford Institute of Oceanography during marine cruises carried out in 1982 and 1985. The most common lithology is light beige to light brown micrite to finely crystalline microsucrosic limestone, containing dark brown bituminous laminae.

Younger Paleozoic beds of Early Silurian (Llandovery) age at one time likely succeeded the Foster Bay Formation of eastern Hudson Strait, as in Foxe Basin, but were removed by processes of subaerial erosion prior to the onset of marine deposition that took place in Hudson Strait, Foxe Channel, Evans Strait and Hudson Bay during Cretaceous (Aptian to Cenomanian) time.

STRUCTURAL FRAMEWORK

Much of the Paleozoic cover that once mantled large segments of the Canadian Shield bordering Hudson and southeast Arctic Platform was uplifted by epeirogenic processes (basement uplift), and eventually removed by subaerial erosion. Some of the more intensive basement movements took place along the axis of the Boothia–Bell Arch, which trends in a southeast direction across Southampton Island and adjacent Foxe Channel, and continues across western Hudson Strait into northern Quebec (Fig. 1). Much of Southampton Island proper is a large, fault-bounded block tilted to the southwest. Similar block-faulting, also tilted to the southwest but on a somewhat smaller scale, occured beneath Foxe Channel as shown in the regional geological map (Fig. 3), and implied by the bathymetric contours (Fig. 5).

Very intensive basement movements in the form of vertical uplift also occurred along the southeast margins of the Keewatin Arch, resulting in the block-faulting of Ordovician rocks in eastern Melville Peninsula and beneath the immediately adjacent waters of Foxe Basin (Fig. 3, 10). Extensive normal faulting also took place on southern Baffin Island, trending in a northwesterly direction from the head of Frobisher Bay to the west side of Putnam Highland, the tilted block thus accounting in large part for the preservation of Ordovician strata in this segment of the Arctic Platform (Fig. 3, 11).

East–west-trending fault systems through segments of Hudson Strait have been mapped by the writers, notably between northern Quebec and Southampton Island, and to the east across the northern margin of Ungava Bay; in the latter area vertical displacements of some 1.5 km have been established (Fig. 3, 5, 8, 12).

Recent subsurface studies of Hudson Bay Basin by Sanford (1987) and Sanford and Grant (1990), from multichannel seismic data, have demonstrated the presence of major fracture systems with vertical displacements of up to 1 km along the axis of the mid-Hudson Bay Arch. These movements are known to have occurred at or near the close of the Early Silurian Llandovery Series. Some of the faulting outlined above in the southeast Arctic Platform may have also occurred during the same period, but this is difficult to confirm, due largely to the absence of Paleozoic strata younger than the Llandovery in this particular region. High-resolution seismic data in southeastern Foxe Channel and Evans Strait show extensive block faulting of Paleozoic and Precambrian terrains partly overlain by Cretaceous-age sediments, the latter in turn locally folded and faulted. It can only be assumed that much of the deformation of Ordovician strata in southeast Arctic Platform may have taken place during the Cretaceous, and possibly even in part, as recently as the Tertiary.

ECONOMIC GEOLOGY

The Ordovician strata of the southeast Arctic Platform contains suitable reservoir and source rocks, and trapping mechanisms for the accumulation of hydrocarbons, provided that suitable conditions of burial prevailed for hydrocarbon generation and migration during the Paleozoic. Conodont

colour alteration indices (CAI) suggest little or no alteration, at least in marginal parts of the Foxe and Hudson Bay basins (McCracken, this volume).

In Foxe Basin, basal sandstones of the Ship Point Formation (and older Cambrian sandstones) and pinnacle reefs in the Foster Bay Formation appear to contain suitable reservoir conditions and stratigraphic traps. The pinchout of basal Ordovician sandstones in the southern and southeastern parts of the basin should contain ideal trapping conditions where they are disconformably overlapped by younger Ordovician and Silurian carbonates. The best source rocks are likely the bituminous rocks of the Boas River (if these prove to be present in the basin), the inter-reefal facies of the Foster Bay Formation, possibly some of the lower bituminous carbonate beds (unit 2) of the Ship Point Formation, and the lower bituminous shaly units 1 and 2 of the Amadjuak Formation.

During a broad reconnaissance of southern Baffin Island by Macauley (1987), shales with varying percentages of total organic content (TOC) were found within the lower intervals (units 1 and 2) of the Amadjuak Formation. According to Macauley (ibid.) "the laminated papery oil shale beds of the Jordan River and Nuvungmiut River sections, containing TOC ranging from 9 to almost 15% are excellent oil shales and potential source beds". Shale samples collected farther northward on the shore of Amadjuak Lake from a similar(?) stratigraphic interval contain TOC percentages of 2.3%. According to Macauley (ibid.) "These (latter) strata do not constitute oil shales, but are significant as a potential petroleum source".

Unfortunately, the total Paleozoic succession (Cambrian, Ordovician and Silurian combined) in the deeper part of Foxe Basin may not exceed 600 m, and thus the region might not be considered a significant future petroleum province. One borehole has been completed in Foxe Basin to date in exploration for oil and gas, and it proved unsuccessful. This was drilled on Rowley Island (Aquitaine et al. Rowley M-04) in 1971 at 69°03'58.48"N, 79°03'48.32"W to a depth of 532 m, terminating 20 m into Precambrian basement rocks.

To the south, beneath the waters of eastern Hudson Strait, Ordovician rocks have similar reservoir and source rock potential as that described above in Foxe Basin. Orthoquartzitic sandstones of the Ungava Bay Formation (identified in Premium Homestead Akpatok L-26 borehole at 60°25'40"N, 68°20'30"W) are present beneath the Strait, as well as patch or pinnacle reef structures contained within the stratigraphically higher Foster Bay Formation. Shales contained within the Amadjuak Formation, and bituminous limestones in the overlying Boas River Formation are potential hydrocarbon source rocks if and where burial conditions were suitable for its generation and migration. During the course of his Baffin Island investigations, Macauley (1987) visited Akpatok Island and sampled the Ordovician succession near the Premium Homestead Akpatok L-26 borehole site, where he found the TOC of the Boas River equivalent to be in the range of 0.5 to 2.0%. Macauley (ibid.) states that "they will have good potential as a petroleum source where present at higher levels of thermal maturity than observed in the sampled area".

Although Ordovician strata are now buried beneath substantial thicknesses of Cretaceous sediments and deep waters of eastern Hudson Strait (Fig. 8), it is doubtful whether they were originally covered by any significant cover of younger Paleozoic rocks that would have triggered the generation and migration of oil and gas deposits, and the region should thus not be regarded as a significant future petroleum province.

The Ship Point Formation in Foxe Basin provides an abundant and excellent quality building stone for construction purposes, and has been used extensively for that purpose in the Igloolik area of Melville Peninsula.

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Appendix 1
Description of surface and subsurface sections on southern Baffin Island and Akpatok Island (including adjacent offshore)[1]

The sections on southern Baffin Island described below were examined by B.V. Sandford, A.C. Grant, and A.D. McCracken in 1998 (see Fig. 11 for locations).

Section	GSC loc.	Description
1	O-104188	Hone River section at faulted Paleozoic/Precambrian contact, 64°13'45"N, 70°37'00"W. ***Amadjuak Formation***: lower beds limestone, light greyish brown, argillaceous to shaly, weathers blue-grey and yellowish orange (unit 2); overlain by limestone, light grey-brown in massive, nodular beds that weather yellowish orange (unit 3); 17 m exposed.
2	O-104189	Hone River section, downstream from section 1, 64°16'20"N; 70°35'20"W. ***Amadjuak Formation***: limestone, light greyish brown, microcrystalline, in irregular nodular beds that weather yellowish orange (unit 3); 17 m exposed.
3	O-104190	Near mouth of Hone River, 64°30'45"N, 70°29'50"W (Fig. 21). ***Frobisher Bay Formation***: limestone on Precambrian rocks, light brown, microcrystalline, in thin, even beds that weather massive, dip to northward off Precambrian high; 3.5 m exposed.
4	O-104191	Small stream-cut on west side of hill north of sharp bend in Hone River where it empties into Amadjuak Lake, 64°35'20"N, 70°37'15"W. ***Amadjuak Formation***: limestone, light brown, finely crystalline, in thin, nodular beds; weathers blue-grey and yellowish orange mottled (unit 2); 13.75 m exposed.
5	O-104192	Summit of ridge south of Nuvungmiut River, 64°31'30"N, 70°10'00"W. ***Amadjuak Formation***: limestone, light brown, microcrystalline, in thin, nodular beds, weathers yellowish-orange and grey mottled (unit 2), about 1 m exposed.
6	O-104193	On west shore of unnamed lake northwest of Sylvia Grinnell Lake, 64°15'30"N, 69°48'50"W. ***Amadjuak Formation***: limestone, light grey-beige, finely crystalline, in thin, irregular beds; weathers grey-orange (unit 2); 11 m exposed.
7	O-104194	Stream-cut flowing into small lake at north end of Putnam Highland, 65°19'00"N, 73°08'30"W (Fig. 27). ***Amadjuak Formation***: limestone, light grey to light brownish grey, thin bedded containing shale partings and thin grey shale interbeds (unit 2); 5.4 m exposed (GSC loc. 69492 of Blackadar, 1967).
8	O-104195	Small stream-cut west of Amadjuak Lake, 65°00'45"N, 75°27'55"W (Fig. 29).
	O-104196	***Akpatok Formation:*** limestone, light grey, argillaceous, in thin, hard beds that weather massive; 9 m exposed; overlain with sharp contact by the ***Foster Bay Formation***, a thin veneer of dolomitic limestone, bituminous, medium brown, thin, platy laminated beds containing small algal (biohermal) masses; less than 1 m exposed. Higher beds are present, largely obscured by talus of similar lithology, but less bituminous. Contact at 9 m above base of outcrop.
9	O-104197	Section on Hone River, 64°18'00"N, 70°30'00"W. ***Frobisher Bay Formation***: limestone on Precambrian, light grey with brownish cast, finely crystalline, thin uniform beds, becoming more massive at top; 9.5 m exposed.
10	O-104198	Silliman's Fossil Mount, head of Frobisher Bay, 63°45'00"N, 68°56'45"W (Fig. 26). ***Amadjuak Formation*** (designated type section): shale, medium to dark grey and black, interbedded with grey-brown shaly limestone (Unit 1), 21 m; overlain by medium grey-brown limestone and grey nodular limestone with interbeds of shale (Unit 2), 34 m; capped by hard, massive weathered, light to medium brown limestone, with yellowish orange mottling (Unit 3), 16 m. Total section exposed, 71 m (GSC loc. 69505 of Blackadar, 1967).
11	O-104199	Southeast side of large outlier, Jordan River 25 km above its mouth, 63°59'15"N, 69°10'00"W (Fig. 22). ***Frobisher Bay Formation***: limestone, light grey, in hard, uniform beds that weather medium grey and brownish grey, with yellowish orange mottling; 5 m exposed.
12	O-104200	Large outlier, section about 30 km above mouth of Jordan River, 63°59'30"N, 69°15'50"W. ***Amadjuak Formation***: limestone, light grey, argillaceous, shale partings and shale interbeds, thin nodular beds, weathers light brown and yellowish orange mottled; 10 m exposed.

[1]For descriptions of Ordovician sections examined on Melville Peninsula by B.V. Sanford and T.E. Bolton in 1973, see p. 2–4 of *Introduction to geology of Ordovician rocks, Melville Peninsula and region*, Geological Survey of Canada, Bulletin 269, 1977.

Section	GSC loc.	Description
13	O-104201	Small stream-cut on large outlier, 63°58'30"N, 69°13'30"W. ***Amadjuak Formation***: limestone, light grey, in uniform to nodular beds, alternating with blue-grey to dark grey and black shale (units 1 and 2); 26 m exposed.
14	O-104202 O-104203 O-104204 O-104205 O-104206	Northwest shore of Amadjuak Lake, section begins at lake level at base(?) of Amadjuak Formation, 65°14'50"N, 71°41'00"W (Fig. 24). ***Amadjuak Formation***: limestone, light grey and brown alternating with dark grey and black shale, recessive. Recessive weathered beds at base, becoming more massive and nodular bedded at top (units 1 and 2); about 30 m exposed. Basal contact of Unit 1 obscured by waters of Amadjuak Lake. Contact of units 1 and 2 is visible but inaccessible in vertical cliff section.
15	O-104207	Small stream gorge cutting rocks stratigraphically higher (30 m above lake level) than section 14, 65°14'25"N, 71°41'25"W (Fig. 25). ***Amadjuak Formation***: limestone, light grey, finely crystalline, nodular beds, weathers yellowish-orange (unit 2), 10 m exposed.
16	O-104208	Small stream-cut at base of small Paleozoic outlier, immediately south of Sylvia Grinnell Lake, 64°05'45"N, 69°26'45"W. ***Frobisher Bay Formation*** (designated type section): limestone on Precambrian, light grey and brown, finely crystalline in nodular beds that weather yellowish-orange (8 m); succeeded by light grey uniformly bedded limestones that weather massive (7 m). Total of 15 m exposed.

Precambrian to Upper Ordovician stratigraphic succession in Hudson Strait, Ungava Bay and Akpatok Island, established by borehole drilling, direct measurement, and/or seismic stratigraphy and shown in Figure 9.

1. Cox (1933), Oxford University expedition in 1931 - Akpatok Formation, 259 m measured.
2, 3, 4. Workum et al. (1976), well site geologist during the drilling of deep basement test on Akpatok Island, measured three sections as follows:
   (2) 0.8 km north of borehole location 27–82 m above sea level, sampled and described Akpatok Formation.
   (3) Gregson Creek, due east of borehole location 0–152 m above sea level, sampled and described Amadjuak, Boas River and Akpatok formations.
   (4) major gully approximately 3.2 km south of borehole location, 0–146 m above sea level, sampled and described Amadjuak, Boas River, and Akpatok formations.
5, 6. James Gray, University of Montreal (pers. comm.), measured and sampled three sections on Akpatok Island:
   (5, 5a) at Harp Cove and Umiak Cove, respectively, 0–100 m above sea level, sampled Akpatok Formation.
   (6) Gregson Creek, due east of borehole location, 0–78 m above sea level, sampled Amadjuak and Akpatok formations.
7. Premium Homestead Akpatok L-26 borehole (see Workum et al., 1976), penetrated 334.7 m of section, Ungava Bay, Frobisher Bay, and Amadjuak formations.
8. Bedford Institute of Oceanography, seismic reflection data from Ungava Bay, defined distribution and approximate thickness of Ungava Bay, Frobisher Bay, and Amadjuak formations.
9. Bedford Institute of Oceanography, seismic reflection data from Hudson Strait, defined distribution and approximate thickness of Ungava Bay, Frobisher Bay, Amadjuak, Boas River, Akpatok, and Foster Bay formations.

ORDOVICIAN MEGAFAUNA, SOUTHERN BAFFIN ISLAND, NUNAVUT

Thomas E. Bolton[1]

Ordovician megafauna, southern Baffin Island, Nunavut; in Geology and paleontology of the southeast Arctic Platform and southern Baffin Island, Nunavut; Geological Survey of Canada, Bulletin 557, p. 39–158.

Abstract

The sedimentary rocks of southern Baffin Island contain a diverse and abundant fauna and flora. The Frobisher Bay Formation contains a *Gonioceras–Labyrinthites* fauna of Middle Ordovician age. The *Pseudogygites–Climacograptus* fauna from a bituminous shale within the lowest unit of the overlying Upper Ordovician Amadjuak Formation is characterized by the trilobites *Pseudogygites* and *Triarthrus* and the graptolites *Amplexograptus praetypicalis* Riva and *Climacograptus* (*Diplacanthograptus*) *spiniferus* Ruedemann; this shale is early Edenian in age, or older. Higher strata of the Amadjuak Formation, which includes Silliman's Fossil Mount, contain the diverse *Kochoceras–Denella* fauna. These beds are early Late Ordovician (Edenian–early Maysvillian) in age. The overlying Akpatok Formation lacks diagnostic fossils, but its *Kionoceras–Maclurina* fauna is believed to be Richmondian in age. A thin remnant of the youngest Ordovician rocks, the Foster Bay Formation, contains only algal masses.

Seven new species are formally described: *Chatetipora amadjuakensis*, *Amsassia floweri*, *Manipora sinclairi*, *Macleodea martini* and *Calyptaulax ludvigseni* from the Amadjuak Formation, and *Kochoceras sanfordi* and *K. maccrackeni* from the Bad Cache Rapids Group of Coats and Southampton islands. Comparative material from Nunavut, Ontario, and Quebec are also illustrated.

Résumé

Les roches sédimentaires de la partie sud de l'île de Baffin contiennent une flore et une faune variées et abondantes. La Formation de Frobisher Bay recèle une faune à *Gonioceras–Labyrinthites* datant de l'Ordovicien moyen. La faune à *Pseudogygites–Climacograptus* d'un shale bitumineux provenant de l'unité basale de la Formation d'Amadjuak sus-jacente est caractérisée par les trilobites *Pseudogygites* et *Triarthrus* et par les graptolites *Amplexograptus praetypicalis* Riva et *Climacograptus* (*Diplacanthograptus*) *spiniferus* Ruedemann; ce shale date de l'Édénien précoce ou est plus ancien. Les strates de la Formation d'Amadjuak qui occupent une position stratigraphique plus élevée, dont celles du mont Silliman's Fossil, comprennent la faune variée à *Kochoceras–Denella*. Ces strates remontent au début de l'Ordovicien tardif (Édénien–Maysvillien précoce). La Formation d'Akpatok sus-jacente ne contient pas de fossiles stratigraphiques, mais on suppose que la faune à *Kionoceras–Maclurina* qu'elle renferme est d'âge richmondien. La Formation de Foster Bay, qui se compose d'un mince lambeau des roches ordoviciennes les plus récentes, ne contient que des massifs algaires.

Les descriptions formelles de sept nouvelles espèces sont présentées : *Chatetipora amadjuakensis*, *Amsassia floweri*, *Manipora sinclairi*, *Macleodea martini* et *Calyptaulax ludvigseni* issues de la Formation d'Amadjuak, et *Kochoceras sanfordi* et *K. maccrackeni* provenant du Groupe de Bad Cache Rapids dans les îles Coats et Southampton. On illustre également des fossiles comparables provenant de Nunavut, de l'Ontario et du Québec.

[1]Geological Survey of Canada, 601 Booth Street, Ottawa, Ontario K1A 0E8 (deceased).

INTRODUCTION

Previous studies of the Ordovician megafauna of southern Baffin Island include those of Schuchert (1900), Gould et al. (1928), Hussey (1928), Foerste (1928a), Wilson (1928, 1931), Roy (1941), Miller et al. (1954), and Whittington (1954). A detailed review of past expeditions and paleontological research was compiled by Miller et al., 1954, p. 5–8, 20–24) and McCracken (this volume), to which the reader is referred. In more recent years, specific taxa within the fauna have been described by Bolton (1977), Copeland (1977), Rigby (1977), Kazmierczak (1989), and McCracken and Nowlan (1989).

The age assigned to the Silliman's Fossil Mount and other isolated exposures located more north and northwest within southern Baffin Island has varied between Richmondian (Troedsson, 1926; Foerste, 1929; Wilson, 1931; Roy, 1941), Trentonian (Schuchert, 1900; Teichert, 1937), or a combination of both (Bassler, 1911; Schuchert, 1914; Foerste, 1928a), and Edenian–Maysvillian (Miller et al., 1954). Sinclair *in* Blackadar (1967, p. 19) and Bolton (1977, p. 26, 27) recognized late Wilderness (Blackriveran–early Trentonian), Barnveld (Cobourgian–Edenian) and post-Barnveld (Maysvillian–Richmondian) faunas. The present research confirms the assignments by Sinclair and Bolton, and defines the characteristic faunal assemblages (faunas) for each formation. Genera and species identified are listed in Tables 1–3. Type specimens are deposited in the National Type Collection of Fossil Invertebrates and Plants, Geological Survey of Canada, 601 Booth Street, Ottawa, Ontario K1A 0E8, and given GSC type numbers. Unless otherwise indicated, all illustrated specimens are hypotypes if formally named, or figured specimens if named in open taxonomy.

The study is based on collections amassed by A.D. McCracken, B.V. Sanford, and A.C. Grant in 1988, and McCracken and G.P. Martin in 1989 (Fig. 1), augmented by other material collected by Y.O. Fortier in 1949 (*see* Wilson *in* Miller et al., 1954) and R.G. Blackadar in 1965 (see Sinclair *in* Blackadar, 1967). Fossils from Southampton Island were collected by B.V. Sanford in 1968 and 1969, and from Coats Island by B.V. Sanford and T.E. Bolton in 1970 (*see* Heywood and Sanford, 1976). Comparative material is illustrated from Anticosti Island, Lac Saint-Jean and Lac Manicouagan, Quebec; Almonte and Collingwood, Ontario; Ellesmere, Akpatok, Coats, Little Cornwallis, Truro, Southampton, and White islands, Aberdeen Lake and Depot Bay, Nunavut.

Thin sections were provided by G.P. Martin and photography by R.J. Kelly, both of the Geological Survey of Canada.

STRATIGRAPHY

The exposed Ordovician rocks of southern Baffin Island are divisible into four formations (Sanford and Grant, 1990; this volume). In ascending order, these are: Frobisher Bay, Amadjuak, Akpatok, and Foster Bay. Locality details can be found in their paper, and in McCracken (this volume).

The Middle Ordovician Frobisher Bay Formation consists of thin, uniformly bedded, greyish brown microcrystalline limestone and dolomitic limestone, disconformably resting on the Precambrian. The Upper Ordovician Amadjuak Formation is divisible into three informal units: a lower Unit 1 of uniform to nodular grey limestone to dark, argillaceous limestone and interbedded shale, locally black and bituminous, disconformably overlying the Frobisher Bay Formation; a middle Unit 2 of nodular, flaggy to rubbly weathering, thin bedded argillaceous limestone with some shale interbeds; and an upper Unit 3 of massive, nodular bedded limestone and dolomitic limestone.

Bituminous or petroliferous shales of the Boas River Formation are widely distributed throughout the Hudson Bay Basin, but to date, they have not been found exposed on Baffin Island. A similar graptolite- and trilobite-bearing shale occurs on Baffin Island in the older Unit 1 of the Amadjuak Formation. The Akpatok Formation overlies the Boas River Formation, presumably with conformity. West of Amadjuak Lake, a small outcrop of the argillaceous nodular limestone of the Akpatok Formation is overlain by a thin remnant of the Foster Bay Formation. This contains thinly laminated, bituminous limestone to crystalline dolomitic limestone and small algal masses.

BIOSTRATIGRAPHY

Four distinctive megafauna assemblages or faunas (Fig. 2), all formerly united as the tropical "Arctic Ordovician Red River" fauna, are definable within the Ordovician rocks of Foxe Basin.

Gonioceras–Labyrinthites fauna

The oldest fauna is from the Frobisher Bay Formation (Table 1). This is seen at several localities, including outcrops along the Hone and Jordan rivers, but is best represented at the Sylvie Grinnell Lake outlier (Section 16). The *Gonioceras–Labyrinthites* fauna is characterized by the cephalopods *Gonioceras wulffi*, *G. holtedali*, *G. groenlandicum*, and *G.* sp. cf. *G. angulatum*, the massive coral *Labyrinthites* (*Labyrinthites*) *chidlensis*, and the

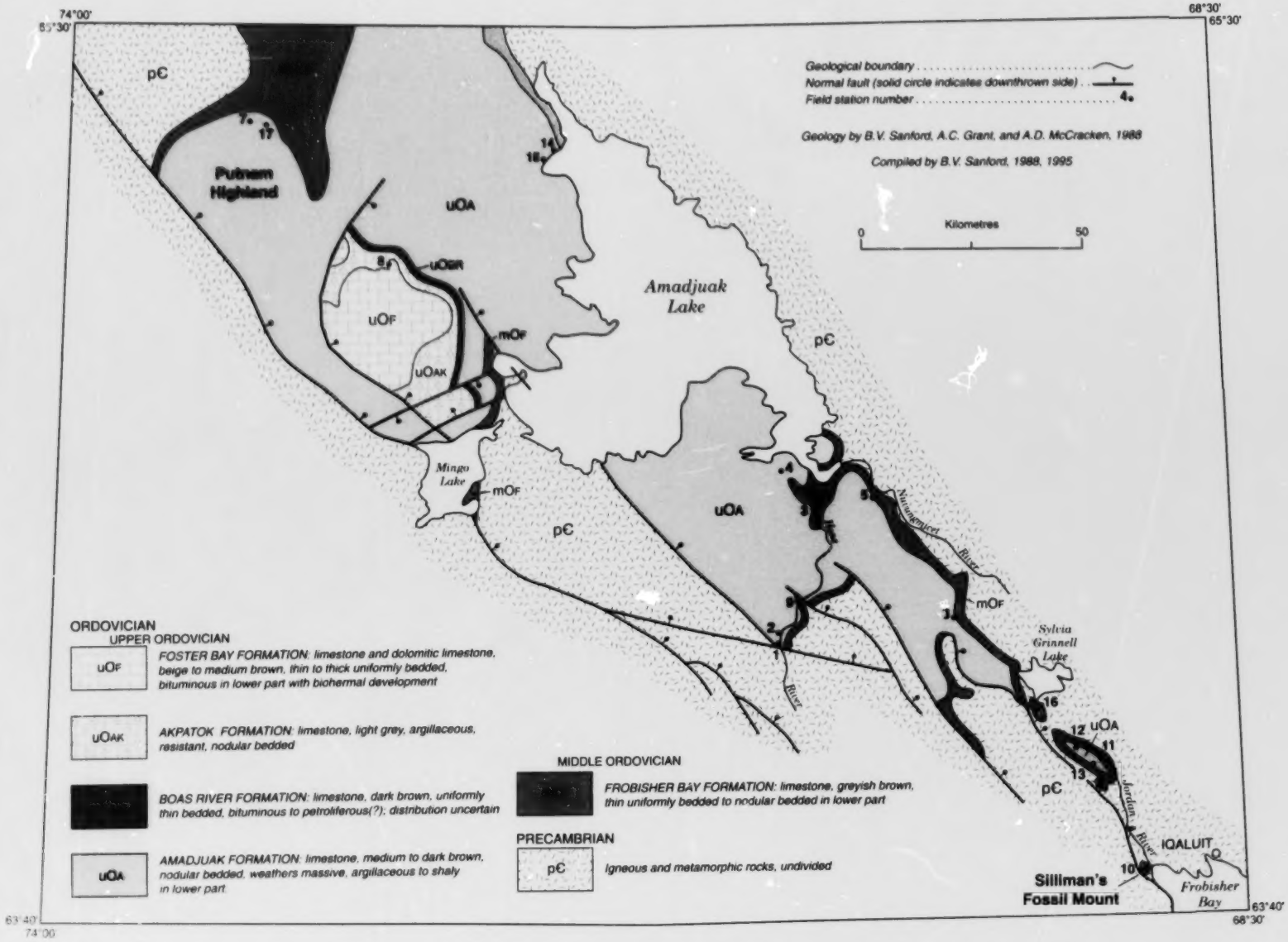


Figure 1. *Collection localities, southern Baffin Island.*

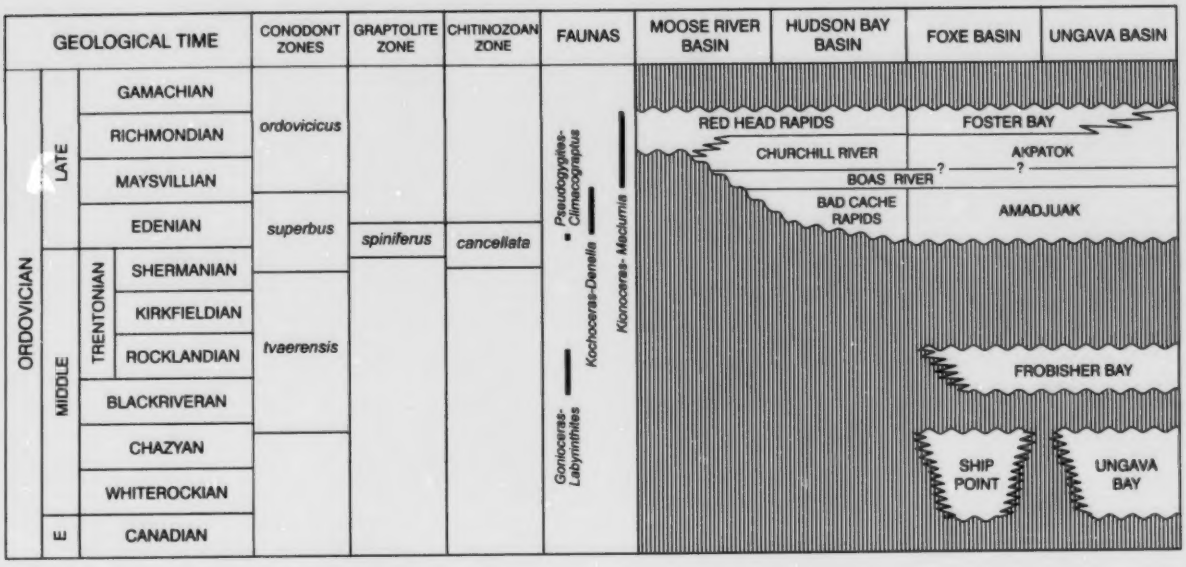


Figure 2. *Stratigraphic nomenclature of Foxe Basin, and correlative strata in adjacent basins.*

sponges *Asteriospongia anatrope* and *Incrassospongia rhipidos*. The nautiloids are dominated by orthocones, and besides *Gonioceras*, they include the characteristic forms *Endoceras chidleyense*, *E.* n. sp. A, *Kochoceras foordi*, *Actinoceras hanseni*, *Richardsonoceras simplex* and *Plectoceras lowi*. The endocerids *E. chidleyense* and *E.* n. sp. A are the most abundant and especially characterize the Frobisher Bay Formation. Also associated with these are the algae *Fisherites occidentalis*.

Bolton (1977) recognized at least two megafaunas within the Bad Cache Rapids Formation of Melville Peninsula. The older was from the lower part (unit 1) of the formation, and it corresponds to the *Gonioceras–Labyrinthites* fauna. On Melville Peninsula, it is typical of the strata at Quilliam Bay (GSC loc. 89833).

The age of this fauna is considered Blackriveran to Rocklandian (Middle Ordovician). The conodont age range of Rocklandian to Shermanian overlaps this estimate (McCracken, this volume).

The faunas of the overlying Amadjuak Formation are the most diverse (Tables 2a, 2b), and are recognizable throughout the Foxe Basin, including higher strata of the former Bad Cache Rapids Formation (Bolton, 1977). On Baffin Island, the dominant invertebrate fossils are corals and nautiloids. *Grewingkia robusta* (Whiteaves) is the most common solitary coral. Tabulate corals, however, are far more numerous: representatives of *Calapoecia* (*C. coxi*, *C. ungava*), *Manipora* (*M. sinclairi*), *Macleodea* (*M. martini*), *Cyrtophyllum* (*C. lambei*, *C. pattersoni*), and *Catenipora* (*C. aequabilis*, *C. rubra*) are numerous. Two faunas are recognized. The lower of the two is characteristic of bituminous beds in Unit 1 of the Amadjuak Formation; the higher is typical of the Silliman's Fossil Mount (Units 2 and 3).

Pseudogygites–Climacograptus fauna

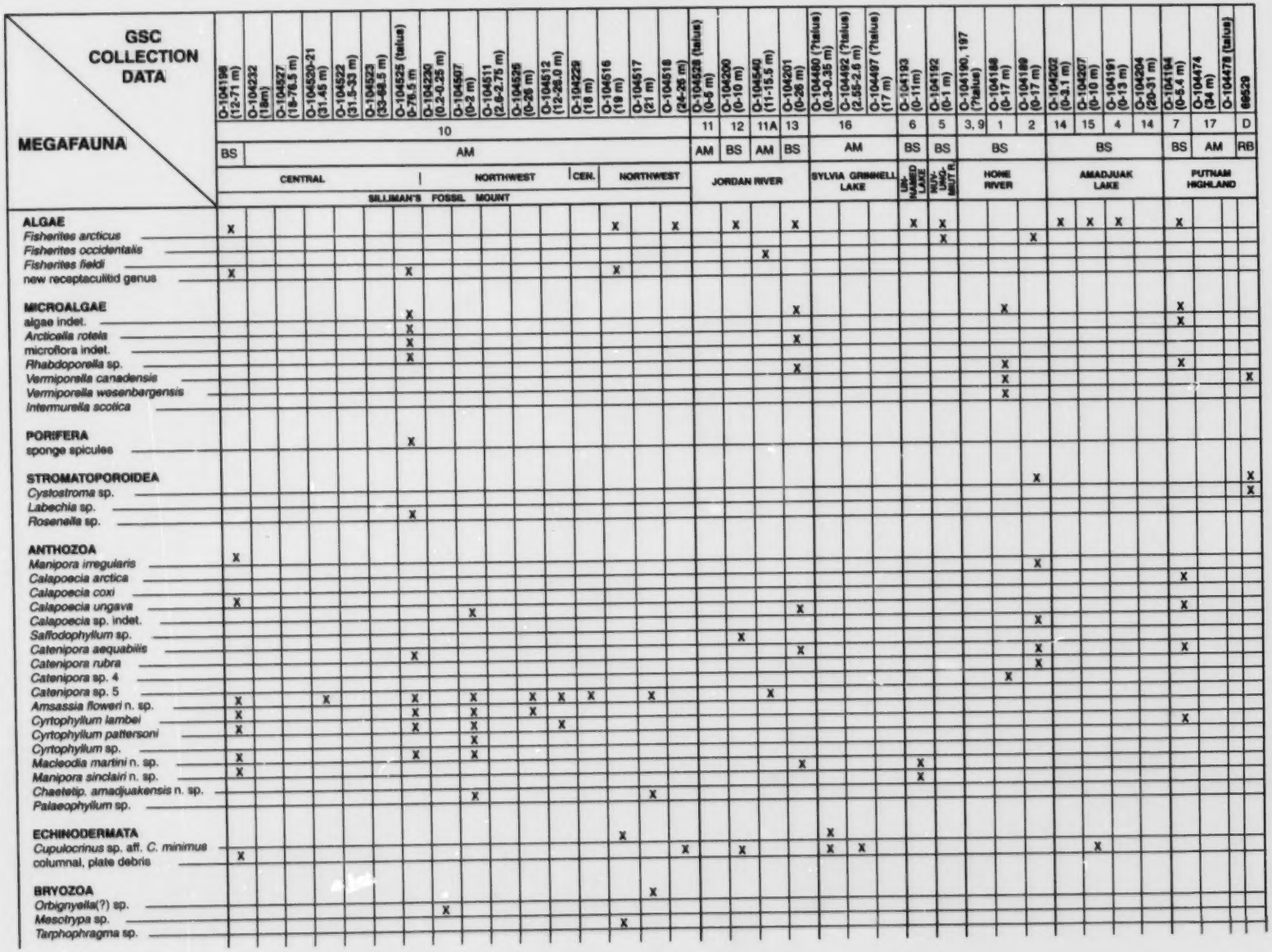
A fauna within the black bituminous beds located in the lowest Unit 1 of the Amadjuak Formation in the Jordan River outlier (Section 11A, above the river outcrop of the Frobisher Bay Formation) is like faunas of similar black and brown shales and limestones found from southern Ontario and northern Michigan north to Southampton Island, Akpatok Island, and Devon, Bathurst, Cornwallis and Truro islands of the Canadian Arctic Archipelago. It is characterized by the trilobites *Pseudogygites* (*P. arcticus*, *P. hudsoni*) and *Triarthrus* (*T.* (*Triarthrus*) *eatoni*, *T.* (*Danarcus*) *glaber*), and the graptolites *Amplexograptus* and *Climacograptus* (Riva, this volume). Also identified at the Jordan River outlier were echinoderm columnals; the brachiopods *Elliptoglossa*(?) sp., *Leptobolus*(?) sp., *Paucicrura* sp. (Pl. 37, fig. 4–6), and sowerbyellid brachiopods; and molluscs, including low-spired gastropods, the pelecypod *Ischyrodonta*(?) sp. and the nautiloid *Geisonoceras* sp. (GSC loc. O-104538 and O-104539).

A mid-Maysvillian to early Richmondian age is generally assigned to this fauna in the Arctic regions of Canada. However, the graptolites are typical of the lower half of the *C.* (*D.*) *spiniferus* Zone throughout New York and southern

Table 1

Middle Ordovician fauna and flora, Frobisher Bay Formation, southern Baffin Island. Collection data comprises GSC locality number, section number or letter, collector (BS = B.V. Sanford, AM = A.D. McCracken, RB = R.G. Blackadar), and geographic locality.

MEGAFAUNA / GSC COLLECTION DATA	O-104199 (0-5 m)	O-104529 (0-1.65 m talus)	O-104530 0-1.65 m (in situ)	O-104208 (0-15 m)	O-104480 (0.3-0.35 m)	O-104481-82 (1.6 m)	O-104483 (2.20 m)	O-104484 (2.25 m)	O-104485 (2.31 m)	O-104486 (2.2-2.4 m)	O-104487 (2.4 m)	O-104490 (2.55 m)	O-104491 (2.55 m)	O-104493 (4.7 m)	O-104494 (6.45-6.5 m)	O-104497 (17 m)	O-104499 (0-18 m, talus)	O-104190 (0-3.5 m)	O-104197 (0-9.5 m)	60401	60513
	11			16														3	9	C	L
	BS	AM		BS	AM													BS		RB	
	JORDAN RIVER			SYLVIA GRINNELL LAKE														HONE R		AMADJUAK LAKE	
ALGAE																					
Fisherites occidentalis		X	X													X			X		
Fisherites sp.									X												X
PORIFERA																					
Asteriospongia anatrope	X																	X		X	
Incrassospongia rhipidos	X	X	X	X										X		X		X		X	
STROMATOPOROIDEA																					
Labechia sp.								X			X										
ANTHOZOA																					
Labyrinthites (*Labyrinthites*) *chidlensis*				X				X			X	X			X		X	X	X		X
Reuschia sp.			X																		
Nyctopora sp.	X																				
ECHINODERMATA																					
columnal debris		X	X	X					X		X				X	X				X	
echinoderm plates				X					X												
BRYOZOA																					
Amplexopora sp. aff. *A. winchelli*	X																				
Rhombotrypa(?) sp.							X		X												
Eridotrypa sp. aff. *E. sadievillensis*			X																		
Ulrichostylus sp.			X																		
Ceramopora sp.			X	X																	
BRACHIOPODA																					
Strophomena sp.	X	X																X			X
Rafinesquina sp.				X														X			
sowerbyellid brachiopod		X																			
GASTROPODA																					
gastropod indet.	X	X											X								
Loxoplocus (*Lophospira*) sp.									X												
NAUTILOIDEA																					
Endoceras chidleyense			X	X															X		
Endoceras sp.	X	X	X	X																	X
Endoceras n. sp. A											X	X	X					X	X		
"*Cyclendoceras*" sp.	X			X		X				X	X										
Actinoceras(?) sp.			X			X				X										X	X
Kochoceras foordi																X			X		
Endoceras(?) sp.				X																	
Actinoceras hanseni																X	X	X	X		
Gonioceras groenlandicum				X													X				
Gonioceras holtedahli												X						X			
Gonioceras wulffi	X	X	X													X		X	X	X	X
Gonioceras sp. cf. *G. angulatum*																	X				
Ormoceras(?) sp.	X			X																	
Ephippiorthoceras sp. cf. *E. compressum*			X																		
Gorbyoceras sp. cf. *G. geronticum*				X												X	X	X			
Gorbyoceras sp.	X			X															X		X
Beloitoceras sp.				X														X			
Digenuoceras(?) sp.				X																	
Richardsonoceras simplex					X				X									X			
Winnipegoceras(?) sp.						X														X	
Discoceras sp. aff. *D. canadensis*				X																	
Plectoceras lowi																			X		
TRILOBITA																					
Illaenus baffinlandicus				X																	
Illaenus sp.	X				X																X
Bumastus (*Bumastoides*) sp.		X							X												
Encrinuroides(?) sp.				X																X	
OSTRACODA																					
leperditipods		X							X							X				X	X


GSC COLLECTION DATA
MEGAFAUNA
O-104198 (12-71 m)
O-104232 (18m)
O-104527 (18-76.5 m)
O-104530-21 (31.45 m)
O-104522 (31.5-33 m)
O-104523 (33-68.5 m)
O-104525 (talus) 0-76.5 m
O-104230 (0.2-0.25 m)
O-104507 (0-2 m)
O-104511 (2.6-2.75 m)
O-104526 (0-26 m)
O-104512 (12-26.0 m)
O-104229 (18 m)
O-104516 (19 m)
O-104517 (21 m)
O-104518 (24-26 m)
O-104528 (talus) (0-5 m)
O-104200 (0-10 m)
O-104540 (11-15.5 m)
O-104201 (0-26 m)
O-104460 (?talus) (0.3-0.35 m)
O-104492 (?talus) (2.55-2.6 m)
O-104497 (?talus) (17 m)
O-104193 (0-11m)
O-104192 (0-1 m)
O-104190, 197 (?talus)
O-104188 (0-17 m)
O-104189 (0-17 m)
O-104202 (0-3.1 m)
O-104207 (0-10 m)
O-104191 (0-13 m)
O-104204 (20-31 m)
O-104194 (0-5.4 m)
O-104474 (34 m)
O-104478 (talus)
69529
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SILLIMAN'S
FOSSIL
MOUNT
JORDAN RIVER
SYLVIA GRINNELL LAKE
UNNAMED LAKE
KUVLUNG-MIUT R.
HONE RIVER
AMADJUAK LAKE
PUTNAM HIGHLAND
ALGAE
Fisherites arcticus
Fisherites occidentalis
Fisherites fieldi
new receptaculitid genus
MICROALGAE
algae indet.
Arcticella rotela
microflora indet.
Rhabdoporella sp.
Vermiporella canadensis
Vermiporella wasenbergensis
Intermurella scotica
PORIFERA
sponge spicules
STROMATOPOROIDEA
Cystostroma sp.
Labechia sp.
Rosenella sp.
ANTHOZOA
Manipora irregularis
Calapoecia arctica
Calapoecia coxi
Calapoecia ungava
Calapoecia sp. indet.
Saffodophyllum sp.
Catenipora aequabilis
Catenipora rubra
Catenipora sp. 4
Catenipora sp. 5
Amsassia floweri n. sp.
Cyrtophyllum lambei
Cyrtophyllum pattersoni
Cyrtophyllum sp.
Macleodia martini n. sp.
Manipora sinclairi n. sp.
Chaetetip. amadjuakensis n. sp.
Palaeophyllum sp.
ECHINODERMATA
Cupulocrinus sp. aff. C. minimus
columnal, plate debris
BRYOZOA
Orbignyella(?) sp.
Mesotrypa sp.
Tarphophragma sp.

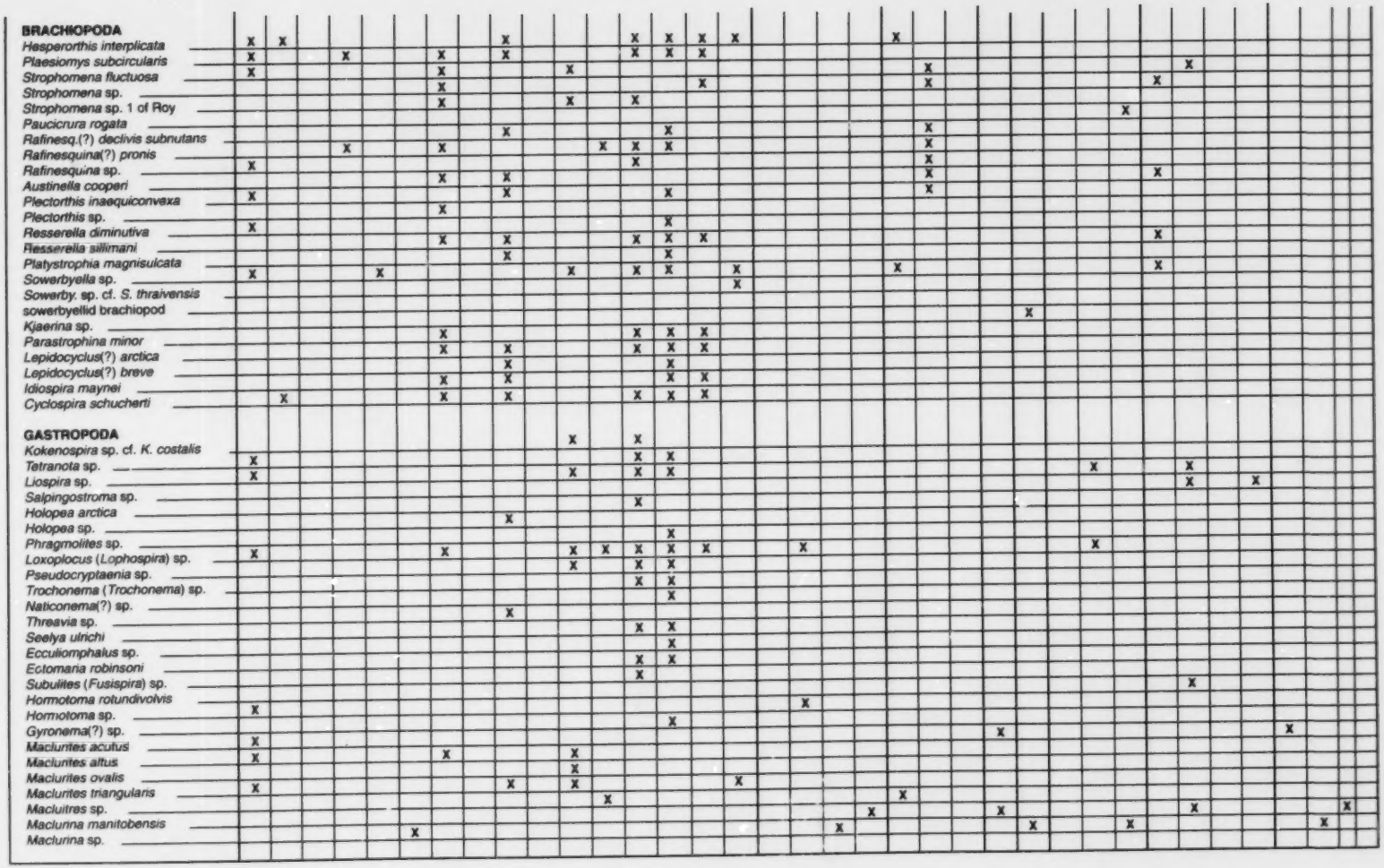
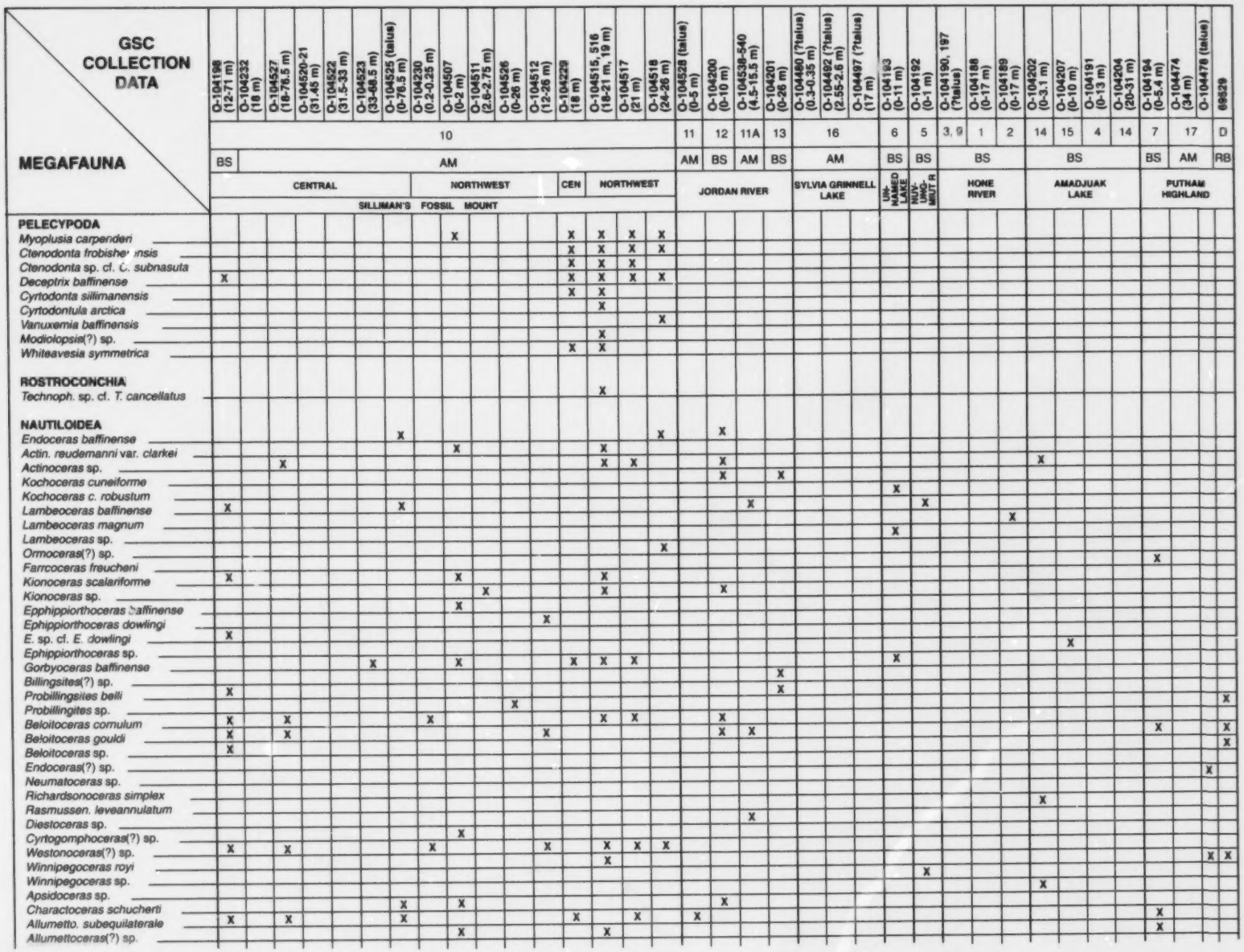


Table 2a

Upper Ordovician fauna and flora, Amadjuak Formation, southern Baffin Island. Collection data comprise GSC locality number, section number or letter, collector (BS = B.V. Sanford, AM = A.D. McCracken, RB = R.G. Blackadar), and geographic locality.


GSC COLLECTION DATA
MEGAFAUNA
O-104198 (12-71 m)
O-104232 (16 m)
O-104527 (16-76.5 m)
O-104520-21 (31.45 m)
O-104522 (31.5-33 m)
O-104523 (33-68.5 m)
O-104525 (talus) (0-76.5 m)
O-104230 (0.2-0.25 m)
O-104507 (0-2 m)
O-104511 (2.6-2.75 m)
O-104526 (0-26 m)
O-104512 (12-26 m)
O-104229 (18 m)
O-104515, 516 (18-21 m, 19 m)
O-104517 (21 m)
O-104518 (24-26 m)
O-104528 (talus) (0-5 m)
O-104200 (0-10 m)
O-104538-540 (4.5-15.5 m)
O-104201 (0-26 m)
O-104480 (?talus) (0.3-0.35 m)
O-104492 (?talus) (2.55-2.6 m)
O-104497 (?talus) (17 m)
O-104193 (0-11 m)
O-104192 (0-1 m)
O-104190, 197 (?talus)
O-104188 (0-17 m)
O-104189 (0-17 m)
O-104202 (0-3.1 m)
O-104207 (0-10 m)
O-104191 (0-13 m)
O-104204 (20-31 m)
O-104194 (0-5.4 m)
O-104474 (34 m)
O-104478 (talus)
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UNNAMED LAKE
HUV-UNG-MUT R
HONE RIVER
AMADJUAK LAKE
PUTNAM HIGHLAND
PELECYPODA
Myoplusia carpenderi
Ctenodonta frobisher ensis
Ctenodonta sp. cf. C. subnasuta
Deceptrix baffinense
Cyrtodonta sillimanensis
Cyrtodontula arctica
Vanuxemia baffinensis
Modiolopsis(?) sp.
Whiteavesia symmetrica
ROSTROCONCHIA
Technoph. sp. cf. T. cancellatus
NAUTILOIDEA
Endoceras baffinense
Actin. reudemanni var. clarkei
Actinoceras sp.
Kochoceras cuneiforme
Kochoceras c. robustum
Lambeoceras baffinense
Lambeoceras magnum
Lambeoceras sp.
Ormoceras(?) sp.
Farrcoceras freucheni
Kionoceras scalariforme
Kionoceras sp.
Epphippiorthoceras baffinense
Ephippiorthoceras dowlingi
E. sp. cf. E. dowlingi
Ephippiorthoceras sp.
Gorbyoceras baffinense
Billingsites(?) sp.
Probillingsites belli
Probillingites sp.
Beloitoceras cornulum
Beloitoceras gouldi
Beloitoceras sp.
Endoceras(?) sp.
Neumatoceras sp.
Richardsonoceras simplex
Rasmussen. leveannulatum
Diestoceras sp.
Cyrtogomphoceras(?) sp.
Westonoceras(?) sp.
Winnipegoceras royi
Winnipegoceras sp.
Apsidoceras sp.
Characteroceras schucherti
Allumettо. subequilaterale
Allumettoceras(?) sp.

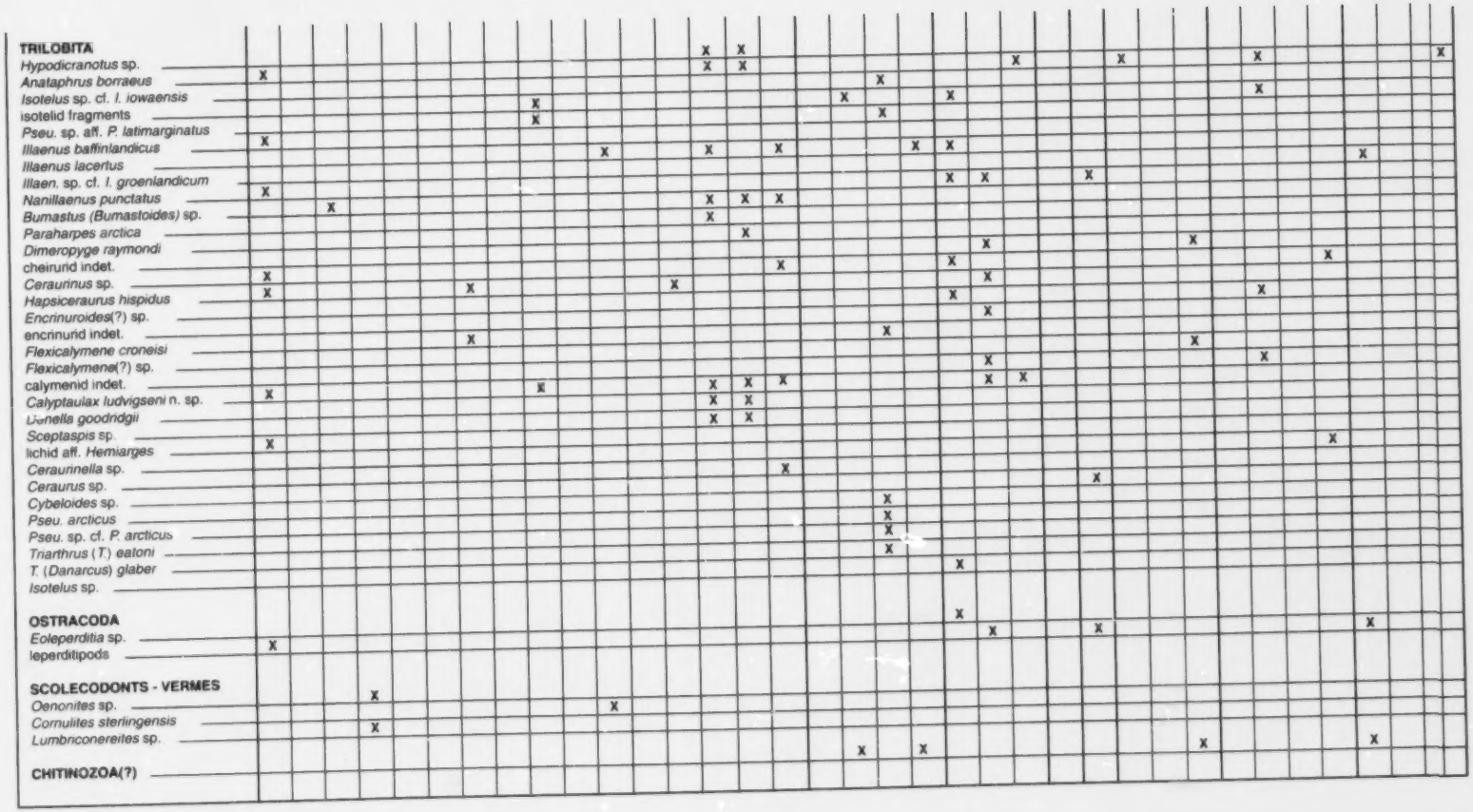

Table 2b

Upper Ordovician fauna and flora, Amadjuak Formation, southern Baffin Island. Collection data comprise GSC locality number, section number or letter, collector (BS = B.V. Sanford, AM = A.D. McCracken, RB = R.G. Blackadar), and geographic locality.

Quebec (Riva, 1987, p. 931; this volume), and thus the Baffin Island fauna is the youngest, early Edenian in age (base of *C. spiniferus* Zone correlates with the base of the Cobourgian–Edenian stages).

Kochoceras–Denella fauna

Succeeding the *Pseudogygites–Climacograptus* fauna is the one best known: the diverse fauna of Silliman's Fossil Mount (Section 10). Other localities containing this fauna include the outliers at Jordan River and Sylvie Grinnell Lake, and outcrops along the Hone River and Amadjuak Lake. The nautiloid fauna of the Amadjuak Formation (Bad Cache Rapids Formation of Bolton, 1977, p. 26) is characterized by the orthocones *Endoceras* (*E. baffinense*), *Actinoceras* (*A. ruedemanni* var. *clarkei*), *Kochoceras* (*K. cuneiforme*, *K. mantelli*, *K. boreale*, *K. breve*), *Lambeoceras* (*L. baffinense*, *L. arcticum*), *Narthecoceras* (*N. sinclairi*), *Farroceras* (*F. freucheni*), *Ephippiorthoceras* (*E. baffinense*, *E. compressum*), and *Gorbyoceras* (*G. baffinense*). Additional typical nautiloid genera include *Probillingsites* (*P. belli*), *Beloitoceras* (*B. cornulum*, *B. gouldi*), *Allumettoceras* (*A. subequilaterale*), *Rasmussenoceras* (*R. leveannulatum*), *Westonoceras* (*W. ornatum*), *Neumatoceras* (*N.*(?) *contractum*, *N. churchillense*) and *Charactoceras* (*C. schucherti*).

The trilobites *Illaenus*, *Nanillaenus*, *Isotelus*, *Sphaerocorphe*, *Anataphrus*, *Bumastus*, *Dimeropyge*, *Hypsiceraurus*, *Calyptaulax*, *Denella*, and *Sceptaspis* further define this fauna. *Anataphrus borraeus*, *Illaenus lacertus*, *I. baffinlandicus*, *Nanillaenus punctatus*, and *Denella goodridgii* are the most dominant forms.

Correlations of this fauna throughout eastern and central North America from New Mexico to Greenland have been reviewed by Bolton (1977, p. 26, 27) and more recently by Frey (1995, p. P10–P20). The age of this fauna is considered Edenian–early Maysvillian.

Kionoceras–Maclurina fauna

The Akpatok and Foster Bay formations are poorly represented in the collections from Baffin Island. At Section 8 (west of Amadjuak Lake; Table 3), the contact of both is exposed in a small section. Talus material (GSC loc. O-104506) contained the nautiloid *Probillingsites belli* (which also occurs in the Amadjuak Formation), the large gastropod *Maclurina*, and the gastropod *Lophospira*(?) sp. Other nautiloid specimens from this material comprise the large, strongly and longitudinally ribbed *Kionoceras* sp., small specimens of *Gorbyoceras*(?) sp., and *Beloitoceras* sp. These last five taxa are different from any Amadjuak Formation forms.

In situ material from the Akpatok Formation (GSC loc. O-104195) contained the brachiopod *Glyptorthis* sp., indeterminate strophomenid brachiopods, large, high-spired gastropods, *Liospira*(?) sp., and the nautiloid *Kionoceras* sp. These could be assigned to either the Amadjuak or Akpatok formations but the closest correlative is the Akpatok Formation of Ungava Bay. This Ungava Bay fauna includes the stromatoporoid *Labechia huronensis*, the corals *Catenipora aequabilis* and *Calapoecia coxi*, the large gastropod *Maclurites ungava* Wilson, the nautiloid *Westonoceras alberta-saskatuanae*, and the trilobite *Pseudogygites akpatokensis* (Wilson, 1938; Bolton *in* Workum et al., 1976). Its age is late Maysvillian–Richmondian, probably the latter. Because of the lack of diversity and material, the *Kionoceras–Maclurina* fauna of Baffin Island does not correlate well with other faunas in the region. At this locality, the Foster Bay Formation contained only algal masses within thin, platy laminated beds.

Table 3

Upper Ordovician fauna and flora, Akpatok Formation, southern Baffin Island. Collection data comprises GSC locality number, section number or letter, collector (BS = B.V. Sanford, AM = A.D. McCracken), and geographic locality.

GSC COLLECTION DATA / MEGAFAUNA	O-104195 (in situ)	O-104506 (talus)
	8	
	BS	AM
	West of Amadjuak Lake	
ECHINODERMATA		
columnal debris		X
BRYOZOA		
indeterminate		X
GASTROPODA		
Maclurina sp.		X
Liospira(?) sp.	X	
Lophospira(?) sp.		X
high-spired indet.	X	
NAUTILOIDEA		
Probillingsites belli		X
Gorbyoceras(?) sp.		X
Beloitoceras sp.		X
Kionoceras sp.	X	X
TRILOBITA		
fragments indet.		X
BRACHIOPODA		
Glyptorthis sp.	X	
strophemenid indet.	X	

TAXONOMIC REMARKS

Some megafossils from Sylvia Grinnell Lake (Frobisher Bay Formation, Section 16, GSC loc. O-104480, O-104492, O-104497) include some that are herein catalogued as "Amadjuak" Formation, "talus" because they are more typical of this formation than the Frobisher Bay Formation. If they are not exotic, then perhaps the species determinations need to be reviewed.

Algae

Receptaculitids are the dominant large algae in the Ordovician beds of southern Baffin Island, occurring in both the Frobisher Bay and Amadjuak formations. The receptaculitids from the Frobisher Bay Formation are *Fisherites* [*Receptaculites* of old] *occidentalis* (Salter) (Pl. 1, fig. 6) and *Fisherites* sp. indet. fragments. Those from the Amadjuak Formation include *Fisherites arcticus* (Etheridge) (Pl. 1, fig. 1–5, 14, 15), *F. fieldi* (Roy) (Pl. 1, fig. 10), *F. occidentalis* (Salter) (Pl. 1, fig. 16), and a new receptaculitid genus (M.H. Nitecki, pers. comm., 1992) formerly assigned by Miller et al. (1954, Pl. 6, fig. 1–4) to *Lepidolites* aff. *L. dickhauti* Ulrich (Pl. 1, fig. 9).

The predominant microalgae are *Vermiporella*, usually enclosed in stromatoporoid and coral colonies, particularly common within chain coral lacunae (see Pl. 2, fig. 13). Within the Amadjuak Formation, *V. canadensis* Horne and Johnson (Pl. 2, fig. 13) is most common in the Jordan River outlier (GSC loc. O-104201), with *V. wesenbergensis* Moskalenko (Pl. 2, fig. 7) present in Putnam Highland, southeast of Bowman Bay (GSC loc. 69529). The former species (Pl. 2, fig. 1–3) is also found on Hone River (GSC loc. O-104188), associated with *Intermurella scotica* Elliott. Many other undetermined microalgae are also scattered throughout the strata (Pl. 1, fig. 13; Pl. 2, fig. 4, 6). These calcareous microalgae have been reported from the Ordovician of southern Hudson Bay as well as from Bathurst, Devon, and Ellesmere islands (Poncet, 1986). Other forms found in those Ordovician rocks include *Vermiporella* cf. *borealis* Hoeg, *Arcticella rotela* Poncet, *Lowvillia raripora* Guilbault and Mamet, and *Halysis moniliformis* Hoeg.

Chitinozoa(?)

Forms common in the Amadjuak Formation, mostly preserved within the lacunae of cateniform corals, are illustrated herein (Pl. 1, fig. 7, 12; Pl. 2, fig. 11, 12). The classification is that adopted for identical forms, also preserved within cateniform lacunae, illustrated from the Late Ordovician White Head Formation of Gaspésie, Quebec (Bolton, 1980, pl. 2.5, fig. 5, 8).

Porifera

Two sponges were described from the Ordovician beds of the Foxe Basin by Rigby (1977). These are *Asteriospongia anatrope* Rigby, recognized on Melville Peninsula and on Baffin Island at the top of a mesa northwest of Amadjuak Lake (GSC loc. 69491), and *Incrassospongia rhipidos* Rigby, from the same locality.

The present study has located both these species within the Frobisher Bay Formation. Both *Asteriospongia anatrope* and *Incrassospongia rhipidos* occur on the Hone River (GSC loc. O-104190, associated with the coral *Labyrinthites* (*Labyrinthites*) *chidlensis* Lambe), on the Jordan River (GSC loc. O-104199), in the Blackadar (1967) collections from GSC loc. 69491 (with the nautiloid *Gonioceras*) and GSC loc. 69504 (north of Silliman's Fossil Mount), and in collections made by Y.O. Fortier in 1949 from 3.2 km west of the Jordan River valley and some 29 km above the river's mouth (GSC loc. 17191). *Incrassospongia rhipidos* also occurs in a small outlier south of Sylvia Grinnell Lake (GSC loc. O-104208, associated with *L.* (*L.*) *chidlensis* and several species of *Gonioceras*, and GSC loc. O-104493, O-104497), and on the Jordan River (GSC loc. O-104529, O-104530).

These sponges are considered to range in age from Blackriveran to Kirkfieldian (lower Franklinian or lower Chatfieldian, Leslie and Bergström, 1995).

Ostracoda

Small and large, smooth leperditicopids are abundant on most rock surfaces (i.e., *Eoleperditia* sp., Pl. 24, fig. 3). The ostrocode fauna of the Frobisher Bay and Amadjuak formations has been detailed by Copeland (1977; this volume).

Stromatoporoidea

Stromatoporoids are not abundant, and consist mainly of labechiids. Small coenostea of *Labechia* and *Cystostroma* were located in both the Frobisher Bay and Amadjuak formations, and *Rosenella* sp. (unfigured specimen GSC 113424) in the Amadjuak Formation (GSC loc. O-104525, Silliman's Fossil Mount). Both *Labechia* and *Cystostroma* are described below.

Anthozoa: Rugosa

Rugose coral genera are represented only by small, angulate solitary forms of *Grewingkia* in the Amadjuak Formation and are not abundant. On Melville Peninsula, in contrast, *Grewingkia robusta* (Whiteaves) and *G. crassa* Elias

(*Streptelasma oppeletum* Teichert of Bolton, 1977, p. 28) have been recognized in equivalent strata.

Anthozoa: Tabulata

Tabulates dominate the coral fauna. The Frobisher Bay Formation is characterized by large domed colonies of *Labyrinthites* (*L.*) *chidlensis* (Pl. 15, fig. 1–5; Pl. 16, fig. 1, 2). Additional genera are *Nyctopora*, *Reuschia*, *Calapoecia* and *Saffordophyllum*. The overlying Amadjuak Formation provides the richest assemblage; most abundant are small mounds to elongate to round colonies of *Amsassia floweri* n. sp. (Pl. 6, fig. 5; Pl. 7, fig. 1–6). Other genera recognized include *Palaeophyllum*, *Chaetetipora*, *Calapoecia*, *Manipora*, *Macleodea*, *Cyrtophyllum* and *Catenipora* (see Systematic Paleontology).

Echinodermata

Circular to pentagonal echinoderm columnals are present in most horizons. Echinoderm plates, with long pore rhombs and four to six ridges extending from their centres that are more like *Hemicystites* in character than *Cheirocrinus* or *Glyptocystites*, were identified in the Frobisher Bay Formation at Sylvia Grinnell Lake (GSC loc. O-104485, Pl. 13, fig. 3, 4, 6 and O-104208, Pl. 13, fig. 5), and in the Amadjuak Formation at Silliman's Fossil Mount (GSC loc. O-104518). Three incomplete, small crowns of the crinoid *Cupulocrinus* sp. aff. *C. minimus* Springer with narrow calyx, high, narrow infrabasals and four primibrachials (Pl. 16, fig. 3–5) were collected from GSC loc. O-104516 (Silliman's Fossil Mount).

Bryozoa

Bryozoa are not abundant in the Ordovician limestones of the Southampton Island–Melville Peninsula–Baffin Island region. Emerson (1879) listed *Stictopora ramosa* Hall? from Frobisher Bay; Bassler (1911, p. 35) identified *Nematopora ovalis* Ulrich and *Pachydictya pumila* Ulrich from Silliman's Fossil Mount. Teichert (1937) described *Rhinidictya* cf. *R. neglecta* Ulrich and *Amplexopora arctica* Teichert from Melville Peninsula. Bolton (1977) reported from these same strata *Helopora* sp., unidentifiable rhinidictyids and pachydictyids, *A. arctica*, and *Diplotrypa bassleri* (Troedsson), the latter species previously being described from Akpatok Island by Bolton (*in* Workum et al., 1976). Roy (1941) identified from Silliman's Fossil Mount *Prasopora* sp., *Batostoma* sp., *Atactoporella* cf. *A. schucherti* Ulrich, *Dianulites* sp. [the coral *Amsassia floweri* n. sp. herein], *Eridotrypa bassleri* Roy, and *Eridotrypa* cf. *E. aedilis minor* (Ulrich).

During the present work, five species of Bryozoa were identified in the Frobisher Bay Formation (Pl. 17, fig. 1–7; Pl. 18, fig. 11, 21) and three in the Amadjuak Formation (Pl. 16, fig. 6–9; Pl. 18, fig. 1, 2) (see Systematic Paleontology).

Brachiopoda

Strophomenids are the dominant brachiopods identifiable in the Frobisher Bay Formation: two specimens of *Strophomena* sp. (Pl. 18, fig. 3, 7) and one *Rafinesquina* sp. (Pl. 18, fig. 5). Some unidentifiable fragments of orthids and hesperorthids were also noted.

In the Amadjuak Formation, brachiopods are far more abundant, particularly at Silliman's Fossil Mount (cf. Roy, 1941, p. 85-106; Miller et al., 1954, pl. 9, 10). The forms recognized in the latest collections include *Lingula* sp., *Hesperorthis interplicata* Roy (Pl. 18, fig. 8–10, 13–17), *Glyptorthis* sp., *Plaesiomys subcircularis* (Roy) (Pl. 18, fig. 18-20, 22, 23; Pl. 19, fig. 3), *Austinella cooperi* Roy (Pl. 19, fig. 1, 2), *Plectorthis inaequiconvexa* Roy (Pl. 19, fig. 4, 5), *Plectorthis* sp., *Hebertella*(?) sp., *Platystrophia magnisulcata* Roy, (Pl. 19, fig. 7, 8, 11, 12), *Paucicrura rogata* (Sardeson) (Pl. 18, fig. 4, 6), *Resserella sillimani* (Roy) (Pl. 19, fig. 9, 10, 14–16, 18, 19, 23), *R. diminutiva* (Roy) (Pl. 19, fig. 6), *Sowerbyella* sp. (Pl. 19, fig. 13, 24) [one small form (Pl. 19, fig. 22) associated with regular *Sowerbyella* pedicle valves at GSC loc. O-104518, Silliman's Fossil Mount, displays a broad sinus similar to that illustrated for *S.* sp. cf. *S. thraivensis* (Reed) from the Amadjuak Formation on Melville Peninsula (Bolton, 1977, Pl. 14, fig. 5)], *Strophomena* sp. 1 of Roy (1941) (Pl. 19, fig. 20, 21), *Strophomena* sp., *S. fluctuosa* Billings (Pl. 20, fig. 34), *Rafinesquina*(?) *pronis* Roy (Pl. 20, fig. 1, 7, 12, 23), *R.*(?) *declivis subnutans* Roy (Pl. 19, fig. 25), *Rafinesquina* sp., *Kjaerina* sp. (Pl. 20, fig. 2), *Parastrophina minor* (Roy) (Pl. 20, fig. 3–6, 8, 18), *Lepidocyclus*(?) *arctica* (Roy) (Pl. 20, fig. 9–11, 13–15, 20), *L.*(?) *breve* Roy (Pl. 20, fig. 19, 24), *Idiospira maynei* (Roy) (Pl. 20, fig. 16, 17), *Cyclospira schucherti* Roy (Pl. 20, fig. 21, 22, 25–28, 32, 33) and *Cyclospira* sp.

The brachiopod fauna of the Amadjuak Formation shows a certain degree of similarity to that of the Bad Cache Rapids Group as found in the Hudson Bay Lowlands (Jin et al., 1997; Jin, pers. comm., 1998).

Mollusca: Gastropoda

Gastropods are rare in the Frobisher Bay Formation; *Loxoplocus* (*Lophospira*) sp. was identified from Sylvia Grinnell Lake (GSC loc. O-104485).

A very diverse fauna of small gastropods characterizes the Amadjuak Formation of Silliman's Fossil Mount. Nineteen genera have been identified: *Bucanella* sp., *Phragmolites* sp. (Pl. 20, fig. 41), *Kokenospira* sp. cf. *K. costalis* (Ulrich and Scofield) (Pl. 20, fig. 29, 30, 36) [*see* Wahlman, 1992, p. O140, pl. 20, fig. 9–12], *Tetronota* sp. (Pl. 20, fig. 31, 40), *Salpingostoma* sp. (Pl. 20, fig. 38) [whorls narrower than *S. soperi* Wilson from the Putnam Highland], *Ecculiomphalus* sp. (Pl. 21, fig. 29), *Liospira* sp. cf. *L. americana* (Billings), *Liospira* sp. (Pl. 20, fig. 35, 37; Pl. 21, fig. 1–4), *Omospira*(?) sp., *Eotomaria robinsoni* Roy (Pl. 21, fig. 5–9), *Loxoplocus* (*Lophospira*) sp. (Pl. 21, fig. 10–12, 14–17), *Pseudocryptaenia* sp. (Pl. 21, fig. 13, 19, 24), *Eunemea* sp., *Trochonema* (*Trochonema*) sp. (Pl. 21, fig. 18, 20, 21), *Holopea* sp. (Pl. 21, fig. 22), *H. arctica* Schuchert (Pl. 20, fig. 39), *Threavia* sp. (Pl. 21, fig. 25) [= *Trochus*(?) species undetermined of Schuchert, 1900, p. 168, Pl. 12, fig. 11–13], *Gyronema*(?) sp. (Pl. 22, fig. 1–4), *Naticonema*(?) sp. (Pl. 21, fig. 23), *Seelya ulrichi* Schuchert (Pl. 21, fig. 27, 28; Pl. 22, fig. 5, 7–9; Pl. 24, fig. 2), and *Subulites* (*Fusispira*) sp. (Pl. 21, fig. 31).

In addition, *Hormotoma rotundivolvis* Roy (Pl. 21, fig. 32) was identified from Amadjuak Lake (GSC loc. O-104207).

Characteristic "Arctic Ordovician" macluritid gastropods are present in most strata of the Amadjuak Formation, and in the Bad Cache Rapids Group on Southampton Island, and in equivalent strata elsewhere in the Foxe Basin. The smaller forms include *Maclurites triangularis* Teichert (Pl. 22, fig. 12, 15, 18, 20, 21) (wide, deep umbilicus and angulate inner margin resembles *M. arcticus* (Haughton) - Pl. 22, fig. 13, 16), *M. altus* Wilson (Pl. 21, fig. 26), *M. ovalis* Wilson (Pl. 22, fig. 14), *M. acutus* Parks (Pl. 21, fig. 30), *M.* sp. cf. *M. acutus* var. *major* Troedsson (Pl. 24, fig. 4, 5), *M. cuneata* (Whitfield), *M. borealis* Wilson, *M. crassus* (Ulrich and Scofield). The large forms are assigned to *Maclurina manitobensis* (Whiteaves) (Pl. 23, fig. 19; Pl. 25, fig. 1, 8) and *Maclurina* sp. (Pl. 22, fig. 17; Pl. 24, fig. 10).

Mollusca: Pelecypoda

The Amadjuak Formation collections contain a number of small forms of Pelecypoda: *Myoplusia carpenderi* (Schuchert) (Pl. 23, fig. 1–3, 7, 10), *Ctenodonta frobisherensis* Schuchert (Pl. 23, fig. 5, 9), *C.* sp. cf. *C. subnasuta* Ulrich (Pl. 22, fig. 6, 10, 11, 19), *Deceptrix baffinense* (Ulrich) (Pl. 23, fig. 4, 6, 8, 11, 12), *Cyrtodonta sillimanensis* Ulrich (Pl. 23, fig. 13, 14), *Cyrtodontula arctica* (Schuchert) (Pl. 23, fig. 20), *Vanuxemia baffinensis* Schuchert (Pl. 23, fig. 21), *Modiolopsis*(?) sp. (Pl. 23, fig. 15), and *Whiteavesia symmetrica* Schuchert (Pl. 23, fig. 18).

Mollusca: Rostroconchia

The rostroconch *Technophorus* sp. cf. *T. cancellatus* Ruedemann (Pl. 23, fig. 22–24) was identified from the Amadjuak Formation at Silliman's Fossil Mount.

Mollusca: Cephalopoda–Nautiloidea

Orthoconic cephalopods are abundant in the Middle Ordovician Frobisher Bay Formation. The endocerids are the most abundant, represented by four species of *Endoceras* (Pl. 25, fig. 7, 10; Pl. 26, fig. 1, 4; Pl. 30, fig. 1; Pl. 39, fig. 6). The Actinocerida is more diverse and includes the genera *Actinoceras* (Pl. 39, fig. 9; Pl. 40, fig. 10), *Kochoceras* (Pl. 27, fig. 2, 3), *Gonioceras* (Pl. 26, fig. 3; Pl. 27, fig. 1, 6, 7, 9, 10; Pl. 28, fig. 2, 7, 8, 12) and *Ormoceras*(?) (Pl. 26, fig. 2). The orthocerid genera include *Ephippiorthoceras* (Pl. 40, fig. 8, 9) and *Gorbyoceras* (Pl. 29, fig. 2, 7–9). The Oncocerida is represented by *Beloitoceras* (Pl. 29, fig. 10, 12), *Digenuoceras*(?) (Pl. 35, Fig. 8, 14), *Richardsonoceras* (Pl. 29, fig. 1, 6), and *Discoceras* (Pl. 26, fig. 9); the Tarphycerida by *Plectoceras* (Pl. 34, fig. 9, 10).

A very diverse nautiloid fauna has been described from the early Late Ordovician Amadjuak Formation exposed at Silliman's Fossil Mount by Miller et al. (1954, p. 15). Twenty-three genera were recognized from a number of taxonomic orders. The new collections from the Amadjuak Formation include the following:

Endocerida: *Endoceras* sp., *E. baffinense* Foerste

Actinocerida: *Actinoceras* sp., *A. ruedemanni* var. *clarkei* Troedsson (Pl. 25, fig. 2), *Kochoceras cuneiforme* Troedsson, *K. cuneiforme robustum* Troedsson, *Lambeoceras baffinense* Miller et al., *L. magnum* Troedsson (Pl. 34, fig. 1), *Ormoceras*(?) sp. (Pl. 39, fig. 4)

Orthocerida: *Farroceras freucheni* (Teichert) (Pl. 32, fig. 3), *Kionoceras* sp. (Pl. 32, fig. 7), *K. scalariforme* (Schuchert) (Pl. 33, fig. 4), *Ephippiorthoceras baffinense* Foerste, *E. dowlingi* Foerste and Savage, *E.* sp. cf. *E. dowlingi* Foerste and Savage, *Gorbyoceras baffinense* (Schuchert) (Pl. 39, fig. 5)

Ascocerida: *Billingsites*(?) sp. (Pl. 24, fig. 11, 13), *Probillingsites belli* Miller (Pl. 34, fig. 2–7)

Oncocerida: *Beloitoceras cornulum* (Schuchert) (Pl. 24, fig. 8; Pl. 35, fig. 13, 15), *B. gouldi* (Foerste) (Pl. 24, fig. 1, 12; Pl. 35, fig. 9, 12), *Neumatoceras* sp. (Pl. 35, fig. 1), *Allumettoceras subequilaterale* Miller (Pl. 39, fig. 8; Pl. 40, fig. 11), *Allumettoceras*(?) sp., *Rasmussenoceras leveannulatum* (Troedsson) (Pl. 39, fig. 1, 7), *Diestoceras* sp. (Pl. 33, fig. 2, 6)

Discosorida: *Cyrtogomphoceras*(?) sp., *Westonoceras*(?) sp. (Pl. 24, fig. 7, 9; Pl, 35, fig. 4, 5), *Winnipegoceras* sp., *W. royi* Miller (Pl. 35, fig. 10, 11)

Tarphycerida: *Apsidoceras* sp. (Pl. 33, fig. 5), *Charactoceras schucherti* Foerste

Nautiloids from the Akpatok and Foster Bay formations of Baffin Island are limited to species of *Probillingsites*, *Kionoceras*, *Gorbyoceras*(?), and *Beloitoceras*.

Trilobita

Trilobites from the Frobisher Bay Formation are *Encrinuroides*(?) sp. (Pl. 31, fig. 2), *Illaenus baffinlandicus* Roy (Pl. 30, fig. 3), *Illaenus* sp. (Pl. 29, fig. 3), and *Bumastus* (*Bumastoides*) sp.

The trilobite fauna present at Silliman's Fossil Mount has been described by Roy (1941) and by Whittington (*in* Miller et al., 1954). Within the present study's collections from the Amadjuak Formation (and mostly from Silliman's Fossil Mount), the following trilobites have been identified: *Hypodicranotus* sp. (Pl. 25, fig. 3, 4), *Anataphrus borraeus* Whittington (Pl. 26, fig. 7; Pl. 36, fig. 2, 4–12), *Isotelus* sp. aff. *I. iowensis* Owen (Pl. 28, fig. 6), *Isotelus* sp. (Pl. 29, fig. 4), *Pseudogygites* sp. aff. *P. latimarginatus* (Hall) (Pl. 32, fig. 8), *Illaenus lacertus* Whittington (Pl. 27, fig. 4, 5; Pl. 29, fig. 5; Pl. 36, fig. 22, 23), *I. baffinlandicus* Roy, *I.* sp. cf. *I. groenlandicum* Troedesson (Pl. 30, fig. 3), *Nanillaenus punctatus* (Roy) (Pl. 24, fig. 6; Pl. 30, fig. 4; Pl. 31, fig. 8; Pl. 36, fig. 25; Pl. 37, fig. 12), *Cybeloides* sp. (Pl. 37, fig. 12), *Bumastus* (*Bumastoides*) sp. (Pl. 29, fig. 11; Pl. 36, fig. 13, 19–21), *Paraharpes arctica* (Whittington) (Pl. 35, fig. 3), *Dimeropyge raymondi* (Roy) (Pl. 26, fig. 5, 8), *Ceraurinella* sp. (Pl. 35, fig. 2), *Ceraurinus* sp. cf. *C. glabra* (Whittington), *Ceraurinus* sp. (Pl. 32, fig. 4), *Ceraurus* sp. (Pl. 25, fig. 5), *Hapsiceraurus hispidus* Whittington (Pl. 34, fig. 8; Pl. 37, fig. 9), *Encrinuroides*(?) sp. (Pl. 28, fig. 3, 4, 9), *Calymene* (s.l.) sp. indet., *Flexicalymene croneisi* (Roy) (Pl. 30, fig. 6), *Flexicalymene*(?) sp. (Pl. 25, fig. 9), *Calyptaulax ludvigseni* n. sp. (Pl. 31, fig. 3; Pl. 36, fig. 8, 24; Pl. 37, fig. 1), *Denella goodridgii* (Schuchert), (Pl. 26, fig. 6; Pl. 35, fig. 7; Pl. 37, fig. 8, 20; Pl. 38, fig. 1–6, 8), *Sceptaspis* sp. (Pl. 28, fig. 10, 11), lichid aff. *Hemiarges* (Pl. 28, fig. 5) (see also Systematic Paleontology).

SYSTEMATIC PALEONTOLOGY

Class Stromatoporoidea Nicholson and Murie, 1879

Family Labechiidae Nicholson, 1879 emend. Stearn, 1980

Genus *Labechia* Milne-Edwards and Haime, 1851

Type species. *Monticularia conferta* Lonsdale, 1839.

Labechia sp.

Plate 4, figures 1, 3-6

Description. Coenostea hemispheric, 50 mm wide and 15mm high (fragment) to thin laminar, 100 mm wide and 3 mm high. In vertical section, cysts are predominantly arched and short, 0.16 to 0.36 mm long and 0.12 to 0.32 mm high, to elongate and laminar, 0.64 to 1.40 mm long and 0.12 to 0.36 mm high, 11 to 12 in 2 mm vertically; pillars solid to clear, usually 0.08 to 0.12 mm in diameter, from 0.36 to 1.44 mm in length, six to seven cysts in 2 mm horizontally. In tangential section, pillars are round, up to 0.08 mm in diameter, and united by curved cyst plates.

Coenosteum in vertical section bulbose, 20 mm high, laterally extending into thin laminate, 100 mm long and 3 mm high; cysts low arched to flat, 0.08 to 0.16 mm high and 0.20 to 0.28 mm long mainly but up to 0.60 mm locally, 13 to 16 cysts in 2 mm vertically; pillars fine, 0.04 to 0.12 mm thick, and 1.00 to 2.40 mm long, six to nine in 2 mm horizontally, rarely branching.

Coenosteum laminate, up to 3 mm thick. In vertical section, pillars clear, 0.16 to 0.20 mm thick, 1.00 to 1.68 mm long, four to six in 2 mm horizontally; cysts mainly flat, 0.08 to 0.20 mm high, 0.20 to 1.24 mm long, occasional low-arched cyst near surface.

Discussion. All elements are finer and the pillars are more abundant in the Frobisher Bay Formation specimens than in the late Late Ordovician *Labechia huronensis* (Billings) (Bolton, 1988, p. 21) or in the early Middle Ordovician *L. prima* Kapp and Stearn (Bolton, 1988, p. 20). Hypotype, GSC 113420a resembles *Stromatocerium rugosum* Hall (Bolton, 1988, p. 21) but the round rather than plate-like pillars rule out such an assignment.

Types. Figured specimens, GSC 113422 Frobisher Bay Formation, GSC loc. O-104487 and GSC 113423, GSC loc. O-104484 (both Sylvia Grinnell Lake). Figured specimen, GSC 113420a, Amadjuak Formation, GSC loc. 69529.

Family Rosenellidae Yavorsky, 1973

Genus *Cystostroma* Galloway and St. Jean, 1957

Type species. *Cystostroma vermontense* Galloway and St. Jean, 1957.

Cystostroma sp.

Plate 4, figures 1, 2, 5

Description. One massive coenosteum is up to 13 mm thick, encrusting. In vertical section, mainly small overlapping cysts, with larger cysts in basal zone and around encrusted *Catenipora* corallites (Pl. 4, fig. 1, 5), ranging from 0.28 to 0.98 mm in length and 0.25 to 0.28 mm in height, seven to ten cysts in 2 mm vertically.

A second massive coenosteum up to 40 mm thick and 100 mm long consists of overlapping cysts ranging from 0.60 to 0.80 mm in length and 0.20 to 0.40 mm in height with rare, larger cysts 1.16 to 2.20 mm in length and 0.28 to 0.60 mm in height, normally seven to nine cysts in 2 mm vertically; mamelons common.

Discussion. There is too little material to permit a specific assignment. The second coenosteum is similar to *C. fritzae* Galloway and St. Jean from the Farr Formation (Edenian) of the Lake Timiskaming area, northern Ontario.

Types. Figured specimen, GSC 113420, Amadjuak Formation, GSC 69529 (Putnam Highland, southeast of Bowman Bay); figured specimen, GSC 113421, Amadjuak Formation, GSC loc. O-104189 (Hone River).

Class Anthozoa Ehrenberg

Subclass Tabulata Milne-Edwards and Haime, 1850

Family Chaetetidae Milne-Edwards and Haime, 1850

Genus *Chaetetipora* Struve, 1898

Type species. *Chaetetipora confluens* Struve, 1898.

Chaetetipora amadjuakensis n. sp.

Plate 6, figures 1, 4, 6, 7

Description. Corallum domical, 70 mm high and 90 mm wide. In transverse section, corallites meandroid, walls thickly trabeculate. In longitudinal section, walls from 0.80 to 2.18 mm long, 0.04 to 0.08 to, rarely, up to 0.16 mm thick, seven to ten in 2 mm horizontally, thin tabulae complete horizontal to slightly inclined, irregularly spaced ranging from 0.08 to 0.20 mm apart, zones of laminae-like tabulae as in stromatoporoides (i.e., *Labechiella*).

Discussion. The very distinct meandroid transverse section and more abundant shorter pillars distinguish the Baffin Island specimen from the described Ordovician forms *C. ellesmerensis* Norford from the Richmondian and Gamachian of arctic, central and eastern Canada (Bolton, 1986) and *C. akpatokensis* (Oakley) from the 137 m (450-foot) elevation within the Maysvillian–Richmondian Akpatok Formation of Akpatok Island.

Type. Holotype, GSC 113425, Amadjuak Formation, GSC loc. O-104193 (unnamed lake northwest of Sylvia Grinnell Lake).

Etymology. After Amadjuak Lake on southern Baffin Island.

Family Cryptolichenariidae Sokolov, 1959

Genus *Amsassia* Sokolov and Mironova, 1959

Type species. *Asmassia radugini* Mironova *in* Sokolov and Mironova, 1959.

Amsassia floweri n. sp.

Plate 6, figure 5; Plate 7, figures 1-6

Dianulites sp. ROY, 1941, p. 82, Fig. 44a-d.

Description. Coralla button-shaped to low mounds to elongate round or lumpy nodular in shape, largest 60 x 40 mm. In transverse section, corallites oval, isolated to compact and polygonal, thin walled (0.01 to 0.02 mm thick), 0.28 to 0.72 mm in diameter, predominantly 0.40 to 0.48 mm. In longitudinal section, corallites long, walls thin, slightly undulating but mainly in contact. Increase axial bipartite, no tabulae preserved.

Discussion. The loose nature of the colonies is a feature more characteristic of anthozoan corallites than bryozoan zooecia. The closely spaced corallites are most suggestive of *A. radugini* Mironova. In that species, however, the corallite diameter ranges from 1.1 to 1.4 mm, and in another closely related species *A. princeps* Mironova the corallites range from 0.73 to 1.0 mm in diameter (Dzuibo, 1960, p. 379).

Amsassia minima Lin and Chow differs from *A. radugini* and *A. floweri* n. sp. in possessing a small number of horizontal tabulae, although Lin and Zou (1980, p. 33) specify no tabulae and thicker walls (0.02 to 0.04 mm); a similar wall thickness is recognized in *A. tudiaoensis* Chow. The corallites of *A. sheshanensis* Deng appear to be more widely spaced and shorter than the Baffin Island forms. In *A. qilianshanensis* Li, the corallites again are more isolated and the walls are thicker (0.05 mm).

The genus is widespread throughout the former U.S.S.R. and northern and southern China, within the American–Siberian realm (Webby, 1992, Fig. 4).

Cornulites sterlingensis Meek and Worthen is shown attached to *A. floweri* n. sp. in Plate 2, figure 8.

Types. Holotype, GSC 113426, Amadjuak Formation, GSC loc. O-104526, paratypes, GSC 113427–113429, Amadjuak Formation, GSC loc. O-104517, O-104526, O-104517 (all Silliman's Fossil Mount), paratype GSC 113430 Amadjuak Formation, GSC loc. O-104540 (Jordan River), unfigured paratype GSC 113431 Amadjuak Formation, GSC loc. O-104526 (Silliman's Fossil Mount).

Etymology. This species is named for Rousseau H. Flower, who contributed so much to our understanding of Ordovician corals and cephalopods.

Family Syringophyllidae Roemer, 1883

Genus *Nyctopora* Nicholson, 1879

Type species. *Nyctopora billingsii* Nicholson, 1879.

Nyctopora sp.

Plate 5, figures 1, 6

Description. Corallum massive, 90 x 70 mm wide, 33 mm high. In transverse section, corallites four- to six-sided, ranging from 1.05 to 1.32 mm in diameter, walls straight with short, thin septa, straight to slightly hooked to slightly undulating, with very short wedge-shaped spines, numbers variable between corallites; small mural pores at corners. In longitudinal section, tabulae complete, horizontal or slightly arched, 0.44 to 0.60 mm apart, four to five in 2 mm vertically.

Discussion. The walls of this Frobisher Bay Formation specimen are thinner, the corallites are smaller and septal spines thinner and shorter than *Nyctopora* sp. described from the Bad Cache Rapids Formation (= Amadjuak Formation) of Melville Peninsula (Bolton, 1977, p. 28). There is a similarity here to *Saffordophyllum* and *Billingsaria*, but the presence of short septa and the lack of a columella is more suggestive of *Nyctopora*. The species *N. billingsii* from the Kirkfieldian of southern Ontario has more septal spines and wider spaced tabulae (Hill, 1961, p. 6), and *N. virginiana* Bassler from the Blackriveran of Virginia has corallites of 1 mm diameter and eight longer, narrow septa (Bassler, 1950, p. 262).

Type. Figured specimen, GSC 113440, Frobisher Bay Formation, GSC loc. O-104199 (Jordan River).

Genus *Reuschia* Kiaer, 1930

Type species. *Reuschia aperta* Kiaer, 1930.

Reuschia sp.

Plate 5, figure 2

Type. Figured specimen, GSC 113441, Frobisher Bay Formation, GSC loc. O-104530 (Jordan River).

Genus *Calapoecia* Billings, 1865

Type species. *Calapoecia anticostiensis* Billings, 1865.

Calapoecia arctica Troedsson, 1928

Plate 5, figure 5

Calapoecia arctica TROEDSSON, 1928, p. 127-129, Pl. 39, fig. 1a, b; Pl. 40, fig. 1a, b.
Calapoecia arctica Troedsson. BOLTON, 1977, p. 28, Pl. 3, fig. 8, 9.

Description. Corallum mound-shaped, 73 mm wide and 47 mm high. In transverse section, 10 mm below corallum surface, corallites round, 3.1 to 3.7 mm in diameter, centres 4.0 to 5.0 mm apart. Very short triangular septal spines and radiating costae uniting in the coenenchyme. In longitudinal section, corallites at surface 2.4 to 3.2 mm in diameter, tabulae complete, horizontal to incomplete, anastomosing, seven to eight in 5 mm vertically, nine to eleven in 5 mm in coenenchyme.

Discussion. The Baffin Island specimen closely matches the colony from the Amadjuak Formation (Bad Cache Rapids Formation; Bolton, 1977, Pl. 3, fig. 8, 9) on Melville Peninsula. The large size of the corallites and the development of coenenchyme distinguishes this specimen from *C. canadensis* Billings, the species characteristic of the late Blackriveran–early Trentonian of southern Ontario.

Type. Hypotype, GSC 113443, Amadjuak Formation, GSC loc. O-104189 (Hone River); unfigured hypotype, GSC 113775, Bad Cache Rapids Group, GSC loc. 83159 (Rocky Brook, Southampton Island).

Calapoecia coxi Bassler, 1950

Plate 8, figures 6, 7

Calapoecia coxi BASSLER, 1950, p. 276, Pl. 17, fig. 20; Pl. 20, fig. 5, 6.
Calapoecia coxi Bassler. BOLTON *in* Workum et al., 1976, p. 168, Pl. 2, fig. 1–3, 8, 9.

Description. Corallum massive, small, 40 mm wide and 15 mm high. In transverse section, corallites rounded to five-sided, 2.6 to 3.9 mm in diameter, in contact with distinct walls irregularly developed, centres 2.4 to 3.2 mm apart.

Septa short, wedge-shaped spines, at least 13 to 14 per corallite, or narrow, short, straight to slightly hooked. In longitudinal section, spines well developed, tabulae horizontal to cystose, seven to nine in 5 mm vertically.

Discussion. The rounded to polygonal corallites in contact or separated by thin coenenchyme, the thick wedge-shaped septal spines and the closely spaced horizontal tabulae are considered characteristic features of *C. coxi*. The holotype and hypotypes are from high in the Akpatok Formation sequence on Akpatok Island. In one corallite, the algae *Rauserina notata* (Antropova) is preserved.

Type. Hypotype, GSC 113444, Amadjuak Formation, GSC loc. O-104194 (Putnam Highland).

Calapoecia ungava Cox, 1936

Plate 8, figures 1-5

Calapoecia canadensis var. *ungava* COX, 1936, p. 12, Pl. 3, fig. 2.
Calapoecia canadensis var. *anticostiensis* Billings. ROY, 1941, p. 74, 76, Fig. 38a–d.
Calapoecia canadensis Billings. MILLER et al., 1954, p. 11, Pl. 8, fig. 2.
Calapoecia ungava Cox. BOLTON and NOWLAN, 1979, p. 10, Pl. 5, fig. 1–3, 6.

Description. Corallum mound-shaped, one specimen is 48 mm wide and 23 mm high. In transverse section, corallites round, 3.4 to 4.2 mm in diameter, centres 3.2 to 3.8 mm apart, walls indistinct to thinly crenulated, corallites in contact or separated by a thin coenenchyme. Short, triangular septa up to 0.52 mm long, at least 16 to 21 per corallite, and short radiating costae in coenenchyme. At outer surface corallites 3.8 to 4.8 mm in diameter in longitudinal section. Tabulae complete, concave to incomplete, anastomosing, variably spaced, three to four in 2 mm vertically, seven to ten in 5 mm both in corallites and coenenchyme.

Discussion. The Baffin Island specimen belongs within the 3.5 to 4.0 mm diameter corallite group recognized by Flower (1961, p. 67) from the Akpatok Formation (where it ranges from sea level to 350 feet (107 m) (ibid. p. 17) of Akpatok Island, and by Bolton (1977, p. 10) from north of Aberdeen Lake. In one corallite, oval tubes of the algae *Halysis* are preserved.

Types. Hypotype, GSC 113445, Amadjuak Formation, GSC loc. O-104198 (Silliman's Fossil Mount); hypotypes, GSC 113776, 113777, Bad Cache Rapids Group, GSC loc. 84561 and 84625 (Rocky Brook and creek 0.8 km west of Coral Harbour, Southampton Island).

Family Favositidae Dana, 1846

Genus *Manipora* Sinclair, 1955

Type species. *Manipora amicarum* Sinclair, 1955.

Manipora sinclairi n. sp.

Plate 9, figures 1-3, 5, 6

Halysites gracilis (Hall). HUSSEY, 1928, p. 71, Pl. 1, fig. 4.
Halysites agglomeratiformis Whitfield. ROY, 1941, p. 77, Fig. 39a-c.
Halysites agglomeratiformis Whitfield. MILLER et al., 1954, Pl. 8, fig. 1.
Quepora?agglomeratiformis (Whitfield). KAZMIERCZAK, 1989, Fig. 2A–C.

Description. Coralla massive, some specimens up to 150 mm wide and 50 mm high. In transverse section, corallites rectangular to subrectangular with outer surface only slightly convex, length 1.2 to 1.6 mm and width 0.90 to 1.20 mm. Thickness of walls variable, straight walls commonly with slight undulations bearing short spines; single ranks with one to three corallites and irregular lacunae. In longitudinal section, tabulae flat to slightly concave, two to four in 2 mm vertically, and spheres of poikiloplasm.

Paratype, GSC 113448 included in this species is an extremely large colony that in transverse section consists of corallites 0.80 to 1.04 mm long and 0.64 to 0.80 mm wide, normally with two to six corallites in closer packed single ranks but with some longer ranks composed of ten corallites.

Discussion. In the western hemisphere, *Manipora* consists of the type species *Manipora amicarum* Sinclair from the Maysvillian Selkirk Member, Red River Formation, southern Manitoba; *M. stearni* (Nelson) from the Edenian Portage Chute Formation, Bad Cache Rapids Group and the Richmondian Caution Creek Formation, Churchill River Group, northern Manitoba; *M.*(?) *delicatula* (Wilson) and *M.*(?) *cylindrica* (Wilson) from the Maysvillian–Richmondian Beaverfoot Formation, southeastern British Columbia; *M. magnus* Flower and *M. trapezoidalis* Flower from the Edenian–Maysvillian Second Value Formation, New Mexico; and *M. feildeni* (Etheridge) (Bolton and Nowlan, 1979, Pl. 4, fig. 1, 4, 5) and *M. irregularis* (Teichert) (Bolton and Nowlan, 1979, Pl. 4, fig. 2; herein Pl. 10, fig. 1, 2; Pl. 12, fig. 6) from the Richmondian of the Canadian Arctic Archipelago.

Other Late Ordovician genera that develop cateniform colonies include the phaceloid *Palaeophyllum* Billings (i.e., *P. cateniforme* Flower, *P. halysitoides* (Wilson), *P. humei* Sinclair, *P. raduguini* Nelson and *P. vaurealensis* Twenhofel

(Bolton, 1979, Pl. 1.3, fig. 1–10), and the cerioid *Saffordophyllum* [a specimen of this genus from the Richmondian Vaureal Formation, Anticosti Island, Quebec (Pl. 10, fig. 4), has a cateniform colony that in transverse section could easily be mistaken for a wide agglomeration of *Manipora* corallites].

The corallites of the Baffin Island species of *Manipora* are less rectangular and smaller, with thicker walls, and the colony on the whole is more compact than in the Late Ordovician *Manipora amicarum*. Nevertheless, the *Saffordophyllum*-like nature of the colonies is more suggestive of *Manipora* than *Catenipora*.

Vermiporella canadensis Horne and Johnson is illustrated (Pl. 2, fig. 13) within lacunae of *Manipora sinclairi* n. sp.

Types. Holotype, GSC 113446, Amadjuak Formation, GSC loc. O-104201 (Jordan River) paratypes, GSC 113447–113449, Amadjuak Formation, GSC loc. O-104198 (Silliman's Fossil Mount), and O-104193 (unnamed lake northwest of Sylvia Grinnell Lake), O-104201 (Jordan River).

Etymology. This species is named for G. Winston Sinclair, Geological Survey of Canada, who contributed much to the solving of Ordovician paleontological and stratigraphic problems of central Canada.

Genus *Saffordophyllum* Bassler, 1950

Type species. *Saffordophyllum deckeri* Bassler, 1950.

Saffordophyllum sp.

Plate 5, figures 3, 4

Description. Corallum 120 x 95 mm wide and 37 mm high. In transverse section, mature corallites range from 3.0 to 4.0 mm in diameter. Walls straight to slightly crenulate. Stubby septal spines not abundant, no mural pores evident. In longitudinal section, corallite diameters mainly 3.2 to 3.6 mm but ranging from 2.5 to 4.0 mm, tabulae complete, flat and usually turning up at walls, widely spaced, four to six in 5 mm vertically.

Discussion. The large corallites and widely spaced tabulae distinguish this specimen from other described *Saffordophyllum* species. *Saffordophyllum*(?) *portagechutense* Nelson from the Bad Cache Rapids Group of northern Manitoba has corallites about 3.5 mm in diameter but averages 10 to 12 tabulae in 5 mm. The corallites of *S. troedssoni* Scrutton from the Centrum and Cape Calhoun formations of northeastern and northwestern Greenland are from 2.3 to 3 mm in diameter and the tabulae have up to 15 corralites in 5 mm.

Type. Hypotype, GSC 113442, Amadjuak Formation, GSC loc. O-104189 (Hone River).

Family Plasmoporellidae Kovalevskiy, 1964

Genus *Macleodea* Flower and Duncan, 1975

Type species. *Mcleodea loisae* Flower and Duncan, 1975. [nom. corr.]

Macleodea martini n. sp.

Plate 10, figures 3, 4, 6; Plate 11, figures 1-5

Plasmopora lambei Schuchert. TEICHERT, 1937, p. 53, 54, Pl. 4, fig. 14; Pl. 5, fig. 1, 2.

Description. Coralla elongate domes, up to 135 mm wide and 60 mm high. In transverse section, corallites round to oval, ranging from 1.00 to 1.56 mm in diameter, separated by single or multiple cystose to polygonal coenenchyme lacking costae, centres generally 2.00 to 2.40 mm apart, ranging between 1.6 and 2.8 mm. Walls solid, crenulated with short septal spines from 10–11 depending upon where sectioned; no costae. In longitudinal section, many stubby corallites with continuous walls or rare overlapping cyst as in *Cyrtophyllum* (Flower and Duncan, 1975, Pl.1, fig. 4) or tabulae extending into coenenchyme (Pl. 11, fig. 2), ranging from 1.00 to 1.40, rarely 1.60 mm, in diameter, tabulae mainly horizontal, variably spaced so that four to eleven are present in 2 mm vertically. Coenenchyme composed of single or wide bands of variably sized cysts.

Discussion. Flower and Duncan (1975) introduced *Macleodea* for heliolitids with definite corallite walls, sparse short septal spines, narrow coenenchyme in general, and flat tabulae. These features appear in the illustrations of *Plasmopora lambei* by Teichert (1937). The Baffin Island species has slightly smaller corallites, a wider coenenchyme and more closely spaced tabulae than *M. loisae* Flower and Duncan.

Types. Holotype, GSC 113450, GSC loc. O-104198 Amadjuak Formation (Silliman's Fossil Mount); paratypes, GSC 113451, 113455, 113456, Amadjuak Formation, GSC loc. O-104198 (Silliman's Fossil Mount) and paratypes GSC 113452–113454 Amadjuak Formation, GSC loc. O-104507 (Silliman's Fossil Mount).

Etymology. This species is named for Gregory P. Martin, lapidary and collections manager, Geological Survey of Canada, in appreciation of the many years of excellent technical support.

Family Cyrtophyllidae Sokolov, 1950

Genus *Cyrtophyllum* Lindström, 1882

Type species. *Cyrtophyllum densum* Lindström, 1882.

Discussion. Two very similar species have been described from Baffin Island within the genus *Plasmopora*: *P. lambei* Schuchert and *P. pattersoni* Roy. According to Roy (1941, p. 72), the former species is composed of corallites averaging 1.25 mm in diameter, 20 costae, and about 20 tabulae in 6 mm vertically, whereas the latter species has corallites averaging 2.25 mm in diameter, 24 costae, and about 30 tabulae in 6 mm. As refined by Bondarenko (1992), neither species can be included in *Plasmopora*, *Plasmoporella*, or *Propora*, but are best assigned to *Cyrtophyllum*. In the present study of Ordovician heliolitids, forms with corallites predominantly 1.9 to 2.5 mm in diameter are assigned to *C. pattersoni* and those with smaller corallites 1.3 to 1.5 mm in diameter to *C. lambei*. The number of costae displayed (20–24) depends on the level of sectioning, and the number and nature of tabulae vary considerably within individual corallite and corallum.

Cyrtophyllum lambei (Schuchert, 1900)

Plate 11, figures 6, 7; Plate 12, figures 1, 2, 4, 7

Plasmopora lambii SCHUCHERT, 1900, p. 154.
Propora lambei (Schuchert). FLOWER and DUNCAN, 1975, p. 185, Pl. 3, fig. 1–7.
Plasmoporella lambei (Schuchert). BOLTON, 1977, p. 30, Pl. 5, fig. 4–7; Pl. 6. fig. 1–4. [includes synonymy]

Description. Corallum massive. One fragment is 135 mm wide and 60 mm high. In transverse section, corallites circular, margins cystose, ranging from 1.32 to 1.50 mm in diameter, centres 1.2 to 2.4 mm apart, 20 to 24 costae, non-polygonal coenenchyme. In longitudinal section, corallites long in centre of colony, more stubby at edges and lower regions, tabulae mainly anastomosing but some are flat and continue into neighbouring coenenchyme, seven to nine in 2 mm vertically, coenenchyme very cystose, cysts frequently overlapping to form "walls" or margins to the corallites.

Discussion. In these specimens, the corallites are commonly longer than in the type material from Silliman's Fossil Mount (Roy, 1941), and the tabulae are closer than those in the Putnam Highland specimens figured previously by Bolton (1977, Pl. 5, fig. 4–7). The species is very similar to *C. troedssoni* Flower and Duncan (formerly *Plasmopora lambei* by Troedsson, 1928) from the Cape Calhoun Formation of northwestern Greenland, which has corallites 1.2 to 1.4 mm in diameter and 28 to 32 tabulae in 5 mm vertically (diameter of corallites in the type of *C. lambei* according to Flower and Duncan (1975, p. 185) is 1.2 to 1.5 mm and there are 28 to 34 tabulae in 5 mm vertically).

Types. Hypotype, GSC 113457 Amadjuak Formation, GSC loc. O-104525 (Silliman's Fossil Mount); hypotypes, GSC 113781, 113782, Bad Cache Rapids Group, GSC loc. 84617 and 84561 (creek 0.8 km west of Coral Harbour and Rocky Brook, respectively, Southampton Island); unfigured hypotypes GSC 42927, 42928, Amadjuak(?) Formation, ("Pope Canyon", Putnam Highland, 65°22'N, approx. 73°W).

Cyrtophyllum pattersoni (Roy, 1941)

Plate 12, figures 3, 5; Plate 13, figures 1, 2, 7, 8

Plasmopora pattersoni ROY, 1941, p. 72, fig. 37a–e.

Cyrtophyllum pattersoni (Roy). BOLTON, 1977, p. 30, Pl. 6, fig. 5, 8–11; Pl. 7, fig. 1–6.

Description. Coralla low domed, up to 165 mm wide and 55 mm high. In transverse section, corallites circular, margins cystose, 1.5 to 2.5 mm in diameter, centres 1.72 to 2.80 mm apart, 20–24 costae either short extensions or connecting corallites. In longitudinal section, corallites generally long. Tabulae flat to anastomosing, particularly at surfaces and edges of coralla, six to eleven in 2 mm vertically, that continue into the coenenchyme, which in turn is composed of a single row of cysts separating corallites or a multitude of variably sized cysts that overlap to form corallite "walls" or margins at various levels within a corallum, abundant vertical costae or plates between which cysts may become more transverse.

Discussion. The abundance of short corallites in the vertical section of hypotype GSC 113459 is similar to *C. lambei* as illustrated by Roy (1941, Fig. 36d, e), but the closer spaced tabulae and larger diameter corallites consign the specimen to *C. pattersoni*.

Types. Hypotypes, Amadjuak Formation, GSC 113459 (GSC loc. O-104507, Silliman's Fossil Mount), GSC 113460 (GSC loc. O-104194, Putnam Highland) and GSC 113461 (GSC loc. O-104198, Silliman's Fossil Mount).

Family Halysitidae Milne-Edwards and Haime, 1849

Genus *Catenipora* Lamarck, 1816

Type species. *Catenipora escharoides* Lamarck, 1816.

Discussion. In the early studies of the Ordovician Arctic chain corals, most colonies were referred to either *Halysites gracilis* Hall or *H. agglomeratiformis* Whitfield. The species *H. gracilis* was recorded by Schuchert (1900), both species by Roy (1941) from Baffin Island and by Troedsson (1928) from the Cape Calhoun Formation of northwestern Greenland. Wilson (1931) described *H. gracilis* var. *borealis* Wilson and *H.* cf. *feildeni* Etheridge from the Putnam Highland of Baffin Island. Teichert (1937) assigned the chain corals from the Ordovician of Melville Peninsula to *H. aequabilis* Teichert and *H. gracilis*. Miller et al. (1954) illustrated *H. agglomeratiformis* Whitfield from Baffin Island. Studies by Sinclair (1955) and Sinclair and Bolton (1956) established *Catenipora rubra* Sinclair and Bolton for forms previously assigned to *H. gracilis* that were found within the Upper Ordovician Selkirk Member, Red River Formation of southern Manitoba. From the Upper Ordovician Bad Cache Rapids and Churchill River groups of northern Manitoba, Nelson (1963) identified *C. rubra*, *C. robusta* (Wilson), *C. stearni* Nelson, *C. aequabilis*, *C. agglomeratiformis*, *C. foerstei* Nelson, *Manipora amicarum* Sinclair, and *M. feildeni*.

In a monumental review of the "Arctic Ordovician" coral fauna, Flower (1961) reassigned the following halysitids within the area of the present research to *Catenipora*: *H.* cf. *feildeni* of Wilson (1931), *H. gracilis* and *H. aequabilis* of Teichert (1937), *H.* cf. *gracilis* of Roy (1941) and *H. agglomeratiformis* of Troedsson (1928); and to *Manipora*: *H. gracilis* var. *borealis* of Wilson (1931), *H. agglomeratiformis* of Roy (1941), and *H. gracilis* and *H. feildeni* of Troedsson (1928). *Catenipora aequabilis* was recorded from Akpatok Island by Bolton (*in* Workum et al., 1976) and from Melville Peninsula by Bolton (1977). *Catenipora agglomeratiformis* was described from 800 m above the base of the Centrum Formation of northeast Greenland by Scrutton (1975, p. 35) and compared with the specimens described by Troedsson (1928) from northern Greenland and by Nelson (1963, p. 58) from northern Manitoba. Finally, in a recent study of the relationship of halysitid corals to sponges, Kazmierczak (1989) based his conclusions on structures within specimens of *Quepora ?agglomeratiformis* (a junior synonym of *Manipora sinclairi* n. sp., above) from Silliman's Fossil Mount.

In the present study, two genera of "halysitidae chain corals without coenenchyme between corallites or at the junction of ranks" are recognized:

Quepora – halysitoid coralla in short single ranks, small lacunae, thick walled corallites with or without septal spines (cf. Pl. 9, fig. 4);

Catenipora – halysitoid coralla in single ranks of varying length, irregular lacunae, corallites elliptical, elongate or angulate–elliptical, septal spines arranged in twelve longitudinal rows (Pl. 14, fig. 5).

An additional non-halysitid genus with cateniform coralla that is common in Late Ordovician strata is *Manipora*. This has single to multiple ranks, irregular lacunae, and thin walled, subquadrate corallites, discontinuous septal spines (*Saffordophyllum*-like coral) (cf. Pl. 10, fig. 1, 2; Pl. 12, fig. 6), and sparse mural pores located in the corners, and rarely in the wall.

Catenipora aequabilis (Teichert, 1937)

Plate 14, figure 6

Halysites aequabilis TEICHERT, 1937, p. 37, Pl. 8, fig. 2; Pl. 9, fig. 4.
Catenipora sp. cf. *C. aequabilis* Teichert. LENZ, 1964, p. 373, Pl. 59, fig. 1–4; text-fig. 1.
Catenipora aequabilis (Teichert). BOLTON, 1977, p. 31, Pl. 7, fig. 7–9, 11. [includes synonymy]

Description. Coralla domed, 180 mm wide and 110 mm high. In transverse section, corallites subrectangular to subelliptical, walls thick, straight common wall, length 1.00 to 1.20 mm and width 0.60 to 0.68 mm, with one to four per single rank and small oval lacunae, short septal spines. In longitudinal section, tabulae complete, flat to gently concave, four in 2 mm vertically, spheres of poikiloplasm arranged in vertical rows.

Discussion. The abundance of oval lacunae and small corallites are characteristics of this species.

Type. Hypotype, GSC 113466, Amadjuak Formation, GSC loc. O-104200 (Jordan River).

Catenipora sp. 4

Plate 14, figure 2

Description. Corallum massive (fragment). In transverse section, corallites subpolygonal to elongate oval, length 1.00 to 1.40 mm and width 0.76 to 0. 80 mm, walls thick, straight common wall, with two or three corallites per single rank and wide oval lacunae, short septal spines. In longitudinal section, tabulae flat to slightly concave, three to four in 2 mm vertically.

Discussion. This form resembles *C. aequabilis* in gross outline but the corallites and lacunae are larger. The straight common walls are suggestive of *Manipora*.

Chitinozoa(?) are illustrated within *Catenipora* sp. 4 on Plate 2, figures 11, 12.

Type. Figured specimen, GSC 113467, Amadjuak Formation, GSC loc. O-104189 (Hone River).

Catenipora sp. 5

Plate 14, figures 1, 5

Description. Corallum massive. In transverse section, corallites elongate oval, length 1.05 to 1.20 up to 1.47 mm and width 0.72 to 0.78 mm; walls thick, with three to eight corallites per rank and variable width lacunae, short septal spines. In longitudinal section, thick tabulae complete, flat to slightly convex, three to four in 2 mm vertically, and spheres of poikiloplasm.

Discussion. This specimen is unique amongst the Baffin Island halysitids.

Type. Hypotype, GSC 113468, Amadjuak Formation, GSC loc. O-104188 (Hone River).

Catenipora rubra Sinclair and Bolton, 1956

Plate 14, figures 3, 4; Plate 15, figures 6-8

Catenipora rubra SINCLAIR and BOLTON, 1956, p. 203, 204.
Halysites cf. *H. gracilis* (Hall). ROY, 1941, p. 79, 80, fig. 40a, b.
Halysites gracilis (Hall). LEITH, 1944, p. 268, Pl. 43, fig. 5, 6.
Catenipora gracilis (Hall). BUEHLER, 1955, p. 36, Pl. 4, fig. 7; Pl. 5, fig. 1.
Catenipora rubra Sinclair and Bolton. SINCLAIR, 1955, p. 99, Pl. 1, fig. 2, 6, 7, 11; text-fig. 2a–c.
Catenipora rubra Sinclair and Bolton. NELSON, 1963, p. 55, Pl. 14, fig. 1, 2.
Catenipora rubra Sinclair and Bolton. ELIAS and LEE, 1993, p. 923, fig. 1.1.

Description. Coralla massive, at least 110 mm wide and 45 mm high. In transverse section, corallites semioval to polygonal with straight, thick common walls that rarely unduiate into short spines, length 1.40 to 2.00 mm and width 1.08 to 1.20 mm, one to eleven corallites per single rank, lacunae narrow and long to circular, no septal spines observed. In longitudinal section, tabulae flat to gently concave, two to five in 2 mm vertically, vertical rows of spheres of poikiloplasm preserved in some corallites.

Discussion. The corallites of the new material from Baffin Island, in general, are smaller than those in the specimen figured by Roy (1941) and within the size of the specimens figured by Leith (1944) and Buehler (1955) from the Selkirk Member, Red River Formation of southern Manitoba.

Types. Hypotypes, GSC 113469–113472, Amadjuak Formation, GSC loc. O-104189 (Hone River), O-104194 (Putnam Highland), O-104525 (Silliman's Fossil Mount), and GSC loc. O-104201 (Jordan River).

Family Tetraporellidae Sokolov, 1950

Genus *Labyrinthites* Lambe, 1906

Type species. *Labyrinthites chidlensis* Lambe, 1906.

Labyrinthites (*Labyrinthites*) *chidlensis* Lambe, 1906

Plate 15, figures 1–5; Pl. 16, figures 1, 2

Labyrinthites chidlensis LAMBE, 1906, p. 328, figure (no number).
Labyrinthites (*Labyrinthites*) *chidlensis* Lambe. BOLTON, 1965, p. 18, 19, Pl. 4, fig. 1–3, 7; Pl. 5, fig. 1–3; Pl. 6, fig. 1, 4, 5; Pl. 7, fig. 1, 6. [includes synonymy]
Labyrinthites (*Labyrinthites*) *chidlensis* Lambe. COPELAND and BOLTON, 1977, p. 3, Pl. 1.3, fig. 1–7.
Labyrinthites (*Labyrinthites*) *chidlensis* Lambe. BOLTON, 1977, p. 31, Pl. 8, fig. 2–4, 7–9, 11.

Description. Low-domed colonies between 110 and 200 mm wide and 35 to 70 mm high, some multilayered. In transverse section, corallites fasciculate, polygonal, four- to five-, rarely six-sided, to oval in outline, 0.28 to 0.56 mm in diameter, isolated to connected at corners by short, hollow tubes (Pl. 15, fig. 3) to even locally cerioid (Pl. 15, fig. 2). In longitudinal section, thin tabulae complete, horizontal to gently concave, 0.4 to 1.15 mm apart, occasional lateral budding (Pl. 15 , fig. 5).

Discussion. *Labyrinthites* has been recognized throughout the western hemisphere: Lourdes Formation, western Newfoundland (Bolton, 1965; Copeland and Bolton, 1977; James and Cuffey, 1989), Lac Manicouagan, Quebec (Bolton, 1965), Cape Chidley, District of Franklin (Bolton, 1965), southern Baffin Island and Melville Peninsula (Bolton, 1977), various islands in the Canadian Arctic (Bolton, 1965), and Brooks Mountain, Alaska (Bolton, 1965). All of these are situated within the warm, shallow equatorial American–Siberian realm (Webby, 1992, p. 261). The rocks bearing this coral usually contain a fauna (*Maclurites–Receptaculites–Hormotoma–Gonioceras*) showing a late Blackriveran–early Trentonian affinity.

In the Lourdes Formation of Newfoundland, the *Labyrinthites*-bearing bioherms are located in the Black Duck Member (Stait, 1988; James and Cuffey, 1989), overlain by the basal shales of the Beach Point Member that bear an ostracode microfauna considered of late Wilderness–Rocklandian age (Copeland and Bolton, 1977, p. 1.3). The bioherms with *Gonioceras* are assigned a late Blackriveran age by Stait (1988, p. 62).

Recently, Desbiens and Lespérance (1989, p. 1191, 1193), based on their studies of the trilobite faunas of the Lac Saint-Jean–Chicoutimi and Lac Manicouagan outliers, Quebec, proposed that the biostratigraphic trilobite succession established by Ludvigsen (1978) within the Middle Ordovician of southern Ontario and adjacent areas was in a local, ecologically controlled environment that slowly invaded eastward during the Middle and early Late Ordovician. Accordingly, the Ordovician limestones of Lac Manicouagan were assigned to the Edenian rather than Blackriveran–Rocklandian. However, it is very probable that within the limestone sequence of Lac Manicouagan are correlatives of both the Blackriveran–Rocklandian Frobisher Bay Formation and the younger Edenian Amadjuak Formation.

Types. Hypotypes, GSC 113473–113475, Frobisher Bay Formation, GSC loc. O-104208 (Sylvia Grinnell Lake), and O-104190 and O-104197 (both Hone River). Additional specimens were found at GSC loc. O-104484, O-104487, and O-104499 (all Sylvia Grinnell Lake), and GSC loc. 69513 (south of Amadjuak Lake).

Class Gymnolaemata Allman

Order Trepostomata

Family Monticuliporidae Nicholson, 1881

Genus *Mesotrypa* Ulrich, 1895

Type species. *Diplotrypa infida* Ulrich, 1886.

Mesotrypa sp.

Plate 16, figures 8, 9

Description. Zoarium domed, 25 mm wide and 15 mm high. In tangential section, zooecia circular to subcircular, 0.28 to 0.36 mm in diameter to 0.48 mm in maculae, seven to seven and a half in 2 mm horizontally, seven to ten whole zooecia in 1 mm square, four to five in maculae, in contact or separated by triangular to four-sided mesozooecia, acanthopores 0.04 mm in diameter clustered at zooecial intersections or, rarely, located in zooecial wall; in longitudinal section, zooecial walls are thin, locally thickened by short acanthopores near the surface, zooecial diaphragms widely spaced, one to two horizontal to curved to inclined to, rarely, cystose per zooecia, to absent, mesozooecia diaphragms closely spaced, usually horizontal.

Discussion. The Baffin Island specimen is close to the Shermanian *M. angularis* Ulrich and Bassler as figured by Karklins (1984, Pl. 9, fig. 3b, c), but its zooecia in longitudinal section are shorter and horizontal diaphragms are more common, but never as abundant as in the holotype (*ibid*., Pl. 9, fig. 2b). There are fewer acanthopores and diaphragms than in the late Ordovician *M. pauca* Utgaard and Perry (1964, Pl. 10, fig. 1, 2).

Type. Figured specimen, GSC 113480, Amadjuak Formation, GSC loc. O-104230 (Silliman's Fossil Mount).

Genus *Orbignyella* Ulrich and Bassler, 1904

Type species. *Orbignyella sublamellosa* Ulrich and Bassler, 1904.

Orbignyella(?) sp.

Plate 16, figures 6, 7

Description. Zoarium encrusting, 0.04 mm thick. In tangential section, zooecia angulate to subcircular, 0.24 to 0.28 mm in diameter, seven in 2 mm horizontally, walls thinly amalgamate, large acanthopores 0.04 mm in diameter, abundant in corners and walls proper, clear centres, no mesozooecia; in longitudinal section, cystiphragm-like diaphragms abundant in basal zone, few straight diaphragms in upper zone.

Discussion. The angular zooecia, large acanthopores and absence of mesozooecia indicate *Orbignyella* rather than *Aspidopora* or *Atactopora*.

Type. Figured specimen, GSC 113481, Amadjuak Formation, GSC loc. O-104517 (Silliman's Fossil Mount).

Family Aisenvergiidae Dunaeva, 1964

Genus *Eridotrypa* Ulrich, 1893

Type species. *Eridotrypa mutabilis* Ulrich, 1893.

Eridotrypa sp. aff. *E. sadievillensis* Karklins, 1984

Plate 17, figures 5, 6

aff. *Eridotrypa sadievillensis* KARKLINS, 1984, p. 69, 70, Pl. 28, fig. 1–3.

Description. Zoarium cylindrical, at least 21 mm long. In tangential section, zooecia polygonal to subpolygonal, walls thin, straight, 0.56 to 0.60 mm in diameter, but ranging from 0.40 to 0.60 mm, rarely 0.80 mm, four and a half zooecia preserved in 2 mm horizontally, only rare, small, angular mesozooecia, no acanthopores; in longitudinal section, wide endozone and narrow exozone, zooecia walls straight to slightly crenulate, thin except for short, thick zone at surface where zooecia open obliquely, diaphragms throughout endozone, thin, horizontal, widely spaced, 2.24 to 3.60 mm apart, and more closely spaced in exozone where flat to inclined to, rarely, cystose, rare, short, beaded mesopore.

Discussion. The Baffin Island specimen differs from *E. sadievillensis* in the greater number of tabulae present throughout the endozone and larger diameter of zooecia. It differs from the more common mid-Ordovician *E. mutabilis* Ulrich in possessing integrated walls and the absence of acanthopores.

Type. Figured specimen, GSC 113482, Frobisher Bay Formation, GSC loc. O-104530 (Jordan River).

Family Amplexoporidae Miller, 1889

Genus *Amplexopora* Ulrich, 1882

Type species. *Amplexopora cingulata* Ulrich, 1882.

Amplexopora sp. aff. *A. winchelli* Ulrich, 1886

Plate 17, figures 1, 3

aff. *Amplexopora winchelli* ULRICH, 1886, p. 91.
Amplexopora aff. *A. winchelli* Ulrich. KARKLINS, 1984, p. 60-62, Pl. 23, fig. 1–5.

Description. Zoarium ramose, at least 80 mm long. In transverse section, zooecia polygonal, four- to six-sided, straight to curved thin walls with median dark line, 0.44 to 0.64 mm in diameter, four zooecia in 2 mm horizontally, rare, small acanthopore in zooecial corner, no mesozooecia. In longitudinal section, wide endozone with thin walls straight to crenulate and rare flat to slightly concave diaphragms at various levels, exozone long, opening obliquely to surface, thick walls with median dark lines, diaphragms abundant, flat to anastomosing, 11 to 12 in 2 mm vertically, about 13 in transverse section.

Discussion. Diaphragms of the Baffin Island specimen are fewer in the endozone and greater in the exozone than in the late Middle to early Late Ordovician *A. winchelli* as figured by Ross (1969, Pl. 37, fig. 2–4) or *A. arctica* as figured by Bolton (1977, Pl. 9, fig. 8–10). They are more like those of *Batostoma winchelli* as figured by Perry (1962, Pl. 6, fig. 7, 9) and of *A.* aff. *A. winchelli* as figured by Karklins (1984, Pl. 23, fig. 3a, 4a, b).

Type. Figured specimen, GSC 113483, Frobisher Bay Formation, GSC loc. O-104199 (Jordan River).

Genus *Rhombotrypa* Ulrich and Bassler, 1904

Type species. *Chaetetes quadratus* Rominger, 1866.

Rhombotrypa(?) sp.

Plate 17, figures 2, 4

Description. Zoarium ramose, 6.5 to 10 mm in diameter over 35 mm length. In tangential section, zooecia five- to six-sided quadrate, thick walls with median dark line, 0.48 to 0.56 mm in diameter, three and one half to four zooecia preserved in 2 mm horizontally, no mesozooecia, no acanthopores. In longitudinal section, zooecia walls thin, straight to undulating in wide endozone with rare, flat diaphragms, walls thick with medium dark lines in exozone, zooecia opening directly to surface, abundant flat to inclined diaphragms, at least 16 to 18 in 2 mm vertically.

Discussion. The Baffin Island specimen is assigned to *Rhombotrypa* rather than *Amplexopora* because of the absence of mesozooecia and acanthopores. It is close to *Rhombotrypa quadrata* (Rominger) as found in the Upper Ordovician Dillsboro Formation of southern Indiana (Brown and Daly, 1985, Pl. 10, fig. 9, 10), but diaphragms are more abundant than in most *R. quadrata* specimens (i.e., Utgaard and Perry, 1964, Pl. 22, fig. 1–4), and closer to *R. multitabulata* Utgaard and Perry (1964, Pl. 20, fig. 5–8) from the Upper Ordovician Whitewater Formation of eastern Indiana and western Ohio.

Type. Figured specimen, GSC 113484, Frobisher Bay Formation, GSC loc. O-104483 (Sylvia Grinnell Lake).

Family Halloporidae Bassler, 1911

Genus *Tarphophragma* Karklins, 1984

Type species. *Monotrypella multitabulata* Ulrich, 1886.

Tarphophragma sp.

Plate 18, figures 1, 2

Description. Zoarium ramose, 6 mm in diameter. In tangential section, zooecia four- to six-sided, thin, amalgamate walls, ranging from 0.20 to 0.32 mm in diameter with seven and one half to eight in 2 mm length and 11 to 14 whole zooecia in 1 mm square, no mesozooecia, rare, minute, acanthopore-like structure at zooecial corners. In longitudinal section, zooecial walls thin, straight, continuous, commonly budding from junction of walls, horizontal diaphragms abundant throughout zoarium, evenly spaced in endozone, three in 1 mm length, closer in exozone, five to seven in 1 mm length.

Discussion. The wider spacing of diaphragms and absence of mesozooecia separates the Baffin Island specimen from *T. multitabulata*. It is quite similar to a form described by Bolton (1996) from the late Middle Ordovician Advance Formation of northern British Columbia.

Type. Figured specimen, GSC 113485, Amadjuak Formation, GSC loc. O-104516 (Silliman's Fossil Mount).

Order Cystoporata Astrova, 1964

Family Ceramoporidae Ulrich, 1882

Genus *Ceramopora* Hall, 1851

Type species. *Ceramopora imbricata* Hall, 1851.

Ceramopora sp.

Plate 18, figures 11, 21

Description. Zoarium thin expansion. In tangential section, zooecia with thin, straight walls, four-to six-sided, 0.12 to 0.20 mm in diameter, mainly 15 zooecia in 2 mm horizontally, no mesozooecia, no acanthopores. In longitudinal section, zooecia long, walls thin, relatively straight, minute communication pores in walls and rarely at corners, rare, thick, slightly concave diaphragm near surface only.

Discussion. This is an extremely well developed ceramoporid with longer zooecia than usual. The closest genus within the Ceramoporidae to have long zooecia is *Papillalunaria*, but the "budlike or knoblike protusions on the proximal side of lunaria" that characterize the genus appear to be lacking in the Baffin Island specimen. It is much like ?*Amsassipora*, but lacks the necessary acanthopores.

Type. Figured specimen, GSC 113486, Frobisher Bay Formation, GSC loc. O-104530 (Jordan River).

Order Cryptostomata Vine, 1880

Family Arthrostylidae Ulrich, 1882

Genus *Ulrichostylus* Bassler, 1952

Type species. *Helopora divaricatus* Ulrich, 1886.

Ulrichostylus sp.

Plate 17, figure 7

Type. Figured specimen, GSC 113487, Frobisher Bay Formation, GSC loc. O-104530 (Jordan River).

Class Cephalopoda Cuvier

Order Endocerida Teichert

Genus *Endoceras* Hall, 1847

Type species. *Endoceras annulatum* Hall, 1847.

Endoceras chidleyense Foerste, 1928b

Plate 25, figure 7; Plate 39, figure 6

Endoceras chidleyense FOERSTE, 1928b, p. 13, Pl. 2, fig. 1; Pl. 22, fig. 1A, B.

Description. Two non-annulated phragmocones – one 78.5 mm long, widening from 45 mm diameter to 49.2 mm, with six camerae per diameter length; sutures transverse; siphuncle 19.5 mm in dorsoventral diameter, holochoanitic located 6 mm from ventral wall. A second more complete specimen is 143 mm long, widening from 47 to 51.5 mm in diameter, with six camerae per diameter length; sutures transverse; siphuncle located away from ventral wall, at least 15.5 mm in diameter.

Discussion. The Baffin Island specimens closely resemble the type specimen from Cape Chidley, northern Labrador.

Types. Hypotypes, GSC 113640, 113759, Frobisher Bay Formation, GSC loc. O-104208 (Sylvia Grinnell Lake) and O-104530 (Jordan River).

Endoceras kindlei (Foerste, 1929)

Plate 30, figure 5

Cyclendoceras kindlei FOERSTE, 1929, p. 152, Pl. 12, fig. 2; Pl. 22, fig. 2.

Cyclendoceras kindlei Foerste. BOLTON, 1977, p. 33, Pl. 11, fig. 2, 7, 8. [includes synonymy; *non* Pl. 11, fig. 1 = *E.* n. sp. A]

Description. A small phragmocone 129 mm long with 13 camerae and a lateral diameter enlarging from 38 mm and five camera per diameter length to 41.4 mm; sutures transverse; strong annulations rising into lateral saddles; siphuncle off-center, 19 mm in diameter.

Discussion. This species name is applied to annulated endocerids of medium size from the early Upper Ordovician Bad Cache Rapids Group (or Formation) of northern Manitoba, Southampton Island, and Melville Peninsula. The species differs from *E. belli* from the same interval in its smaller diameter, more closely spaced sutures, and weaker annulations. In contrast to *E.* n. sp. A from the Middle Ordovician Frobisher Bay Formation of Melville Peninsula and Baffin Island, sutures in *E. kindlei* are further apart and phragmocones are less compressed.

Types. Hypotype, GSC 113800, Bad Cache Rapids Group, GSC loc. 84617 (creek 0.8 km west of Coral Harbour, Southampton Island); unfigured hypotypes, GSC 42973–42975, Frobisher Bay Formation, GSC loc. 89833 (Quilliam Bay, Melville Peninsula).

Endoceras n. sp. A

Plate 25, figure 10; Plate 26, figure 1; Plate 30, figure 1

Cyclendoceras kindlei Foerste. BOLTON, 1977, p. 33, Pl. 11, fig. 1 (only).

Description. Figured specimen, GSC 113641: a straight endocerid, oval section depressed dorsoventrally consisting of a phragmocone 180 mm long with 35 camerae enlarging from a lateral diameter of 34.5 mm and 24.4 mm dorsoventrally to 45 mm laterally at base of living chamber, plus a living chamber of at least 61 mm length with a lateral diameter of 50 mm at apex; sutures straight, transverse, seven and one half to eight camerae per length; annulations well preserved.

Figured specimen, GSC 113642: a slightly larger, dorsoventrally depressed phragmocone with elliptical cross-section; 81.5 mm long with 13 camerae, enlarging from 39 to 44 mm lateral diameter, sutures straight, transverse, 6 mm apart; siphuncle near ventral wall, 13 mm in diameter.

Figured specimen, GSC 113643: a still larger, but incomplete straight phragmocone 210 mm long with 29 camerae and a lateral diameter enlarging from 51.8 to 63.5 mm, eight to nine camerae per diamater length; sutures straight, transverse; siphuncle slightly away from wall, 21.3 mm in diameter with well developed endosiphuncular tube; slight trace of annulations.

Discussion. Figured specimen, GSC 113641 is closely similar to the long form of *E. kindlei* from Melville Peninsula (Bolton, 1977, Pl. 11, fig. 1). The species is distinguished by its closer spaced sutures and, in general, smaller diameter compared to *E. kindlei* and *E. belli*.

Types. Figured specimens, GSC 113641, Frobisher Bay Formation, GSC loc. O-104491 (Sylvia Grinnell Lake); figured specimens, GSC 113643, 113642, GSC loc. O-104190 and O-104197 (both Hone River), Baffin Island; unfigured specimen GSC 113772, Frobisher Bay Formation, GSC loc. O-104487 (Sylvia Grinnell Lake); unfigured specimen, GSC 42972, Frobisher Bay Formation, GSC loc. 89868 (Roche Bay, Melville Peninsula).

Endoceras belli (Nelson, 1963)

Plate 30, figure 7; Plate 31, figure 6

Cyclendoceras belli NELSON, 1963, p. 69, Pl. 17, fig. 1; Pl. 18, fig. 1a, b.

Description. Straight annulated phragmocones. One specimen is 250 mm long, dorsoventrally compressed, elliptical in transverse outline, lateral diameter enlarging from 53 to 55 mm; annulations strong curving apicad to form saddles, crests at least 7 mm apart; elliptical siphuncle enlarges from 16.5 to 19 mm diameter. A second specimen is 365 mm long, of which 160 mm is phragmocone with at least 14 camerae, expanding from 46.5 to 60.3 mm; anterior end of living chamber 67 mm in diameter.

Discussion. This species differs from *E. kindlei* by its stronger, inclined annulations.

Types. Hypotypes, GSC 113801, 113805, Bad Cache Rapids Group, GSC loc. 85505 (Coats Island).

Order Actinocerida Teichert

Genus *Actinoceras* Bronn, 1837

Type species. *Actinoceras bigsbyi* Bronn, 1837.

Actinoceras hanseni (Foerste, 1921)

Plate 39, figure 9

Leurorthoceras hanseni FOERSTE, 1921, p. 278, Pl. 30, fig. 1A, B; Pl. 31, fig. 1; Pl. 32, fig. 8; Pl. 34, fig. 2.

Description. Straight nautiloid composed of a body chamber 20 mm long and a compressed phragmocone with ventral

side slightly convex and dorsal side more convex, 170 mm long with 25 camerae, lateral diameter enlarging from 35 mm with five and one half camerae per diameter (dorsoventral diameter 28 mm) to 57.5 mm and seven camerae per diameter; ventral sutures broad shallow lobes, dorsal sutures straight, and lateral low saddles, 8 mm apart; circular siphuncle 2 mm in from ventral surface, 6+ mm in diameter at a lateral diameter of 40 mm; smooth surface heavily burrowed. A second incomplete specimen composed of a body chamber 26 mm long and a phragmocone 75 mm long with 11 camerae, lateral diameter enlarging from 32 mm with five camerae per diameter to 44 mm with seven camerae per diameter, ventral sutures low, shallow lobes 7 mm apart.

Discussion. *Leurorthoceras* was regarded as a junior synonym of *Actinoceras* by Flower (1957). The cross-sections of the Baffin Island specimens are more elliptical than subtriangular as in the type specimen.

Types. Hypotypes, GSC 113761, 113770 (unfigured), 113771 (unfigured), Frobisher Bay Formation, GSC loc. O-104190 and O-104197 (both Hone River), and O-104497 (Sylvia Grinnell Lake).

Actinoceras(?) sp.

Plate 40, figure 10

Description. Straight orthocones: one with 17 camerae enlarging from 22 to 35 mm, cross-section subcircular, sutures straight, 6.5 to 8 mm apart, siphuncle large, touching ventral wall, 19.6 mm in diameter laterally and 16.6 mm dorsoventrally; a second is 90 mm long with 16 camerae enlarging from 27 to 34.4 mm, six camerae per diameter, 10 mm apart, cross-section circular to subcircular, sutures straight, siphuncle at least 12 mm in diameter laterally.

Types. Figured specimen, GSC 113768, unfigured specimen 113773, Frobisher Bay Formation, GSC loc. O-104482 and O-104486 (both Sylvia Grinnell Lake).

Genus *Kochoceras* Troedsson, 1926

Type species. *Kochoceras cuneiforme* Troedsson, 1926.

Kochoceras sanfordi n. sp.

Plate 31, figures 7, 9

Description. Two phragmocones, one 140 mm long with 12 camerae and the other 132 mm long with ten camerae, expanding from 35.5 mm lateral diameter and five camerae per diameter to 65 mm and six camerae per diameter; venter convex at base but flattened the remainder of the phragmocone, dorsal surface gently curved; septum at apex obliquely funnel-shaped with endosiphuncular tube of siphuncle near the ventral side opening dorsally as in *K. boreale*, siphuncle up to 30 mm diameter at anterior end.

Discussion. This new species is close to *K. tyrrelli* Foerste from the Red River Formation of southern Manitoba, but it does not expand as rapidly and the sutures are shallower and closer.

Types. Holotype, GSC 113807, paratype, GSC 113806, Bad Cache Rapids Group, GSC loc. 85505 (Coats Island).

Etymology. The species is named in honour of Bruce V. Sanford, Geological Survey of Canada, in recognition of his many contributions to our knowledge of the Paleozoic stratigraphy of Ontario and the Hudson and Foxe basins.

Kochoceras maccrackeni n. sp.

Plate 31, figures 1, 4, 5

Description. Three incomplete, straight, dorsoventrally compressed phragmocones. Holotype, GSC 113803, is 108 mm long with six camerae, expanding from 33.7 mm lateral diameter and two and three quarter camerae per diameter to at least 50 mm; venter flat, dorsal surface curved; septum at base funnel-shaped with circular, 10 mm in diameter endosiphuncular tube opening located at apex near ventral wall; septa widely spaced, gently concave; siphuncle at least 29 mm in diameter at anterior end.

Paratype, GSC 113804, is 78 mm long with three (plus) camerae, enlarging from 35 mm lateral diameter and two (plus) camerae per diameter to 47 mm; venter flat to depressed anteriorly; sutures slightly concave, septa strongly concave; siphuncle large, almost filling the phragmocone but not compressed, pulling away slightly from the walls as the phragmocone expands; endosiphuncular tube at least 10 mm in diameter with 6.2 mm opening.

Paratype, GSC 113802, is 140 mm long with eleven camerae expanding from 43 mm in diameter to at least 85 mm, three (plus) camerae per diameter; ventral surface slightly concave, dorsal convex, septa gently concave; siphuncle large, 40.3 mm in diameter and increasing in diameter anteriorly, as well as withdrawing from walls.

Discussion. The deep camerae and relatively low rate of shell expansion distinguishes this species from previously described forms.

Types. Holotype, GSC 113803, Bad Cache Rapids Group, GSC loc. 84617; paratypes, GSC 113802, 113804, Bad Cache Rapids Group, GSC loc. 83151 (both localities on a creek 0.8 km west of Coral Harbour, Southampton Island).

Etymology. This species is named in honour of Alexander D. McCracken, Geological Survey of Canada, in recognition of his contributions to our knowledge of the Ordovician–Silurian conodont faunas of Canada.

Kochoceras foordi Foerste, 1928b

Plate 27, figures 2, 3

Kochoceras foordi FOERSTE, 1928b, p. 70, Pl. 6, fig. 3.
Kochoceras foordi Foerste. BOLTON, 1977, p. 33, Pl. 12, fig. 1.

Description. Dorsoventrally compressed phragmocone, venter slightly convex, 75 mm long with ten camerae 7.8 mm apart, and a lateral diameter enlarging from 24 mm with three and one half camerae per diameter to 37 mm and five camerae per diameter; sutures concave rising to low, wide lateral saddles; siphuncle 17.2 to 22 mm lateral diameter in contact with ventral surface.

Discussion. Rate of enlargement and number of camerae per diameter of the Baffin Island specimen are similar to the shorter type specimen from Igloolik Island, Melville Peninsula, and these features separate it from the more straight-sided *K. mantelli* from the same locality.

Types. Hypotypes, GSC 113653, 113774 (unfigured), Frobisher Bay Formation, GSC loc. O-104497 (Sylvia Grinnell Lake) and O-104197 (Hone River).

Genus *Gonioceras* Hall, 1847

Type species. *Gonioceras anceps* Hall, 1847.

Discussion. Numerous species of *Gonioceras* have been proposed over the years, but many are poorly defined (Stait, 1988, p. 65). Based on such persistent features as differences in median lobe width and rate of enlargement, and the angularity of the lateral saddles, the northwestern Greenland species *G. wulffi* Troedsson, *G. holtedali* Troedsson, *G. groenlandicum* Troedsson, and *G.* sp. cf. *G. angulatum* Troedsson are considered recognizable within the Middle Ordovician Frobisher Bay Formation of Baffin Island and Melville Peninsula.

Gonioceras wulffi Troedsson, 1926

Plate 26, figure 3; Plate 27, figures 1, 7, 10

Gonioceras wulffi TROEDSSON, 1926, p. 85, Pl. 51; Pl. 52; Pl. 53, fig. 5.
Gonioceras sp. cf. *G. wulffi* Troedsson. BOLTON, 1977, p. 33, Pl. 12, fig. 7; Pl. 13, Fig. 1, 3.

Description. Large, dorsoventrally depressed phragmocone, venter and dorsum both slightly convex, 168 mm long with 36 camerae, median lobe enlarging from 49 mm diameter and 12.5 camerae per diameter to at least 79 mm and 16 camerae per diameter; septa shallow concavity 4.4 to 5.2 mm apart; low lateral saddles and gently sloping lateral lobes; siphuncle near venter, 14.2 mm diameter at apical end. A second, larger phragmocone is 225 mm long with at least 38 camerae and a median lobe enlarging from 74 to 113.5 mm and low lateral saddles.

Discussion. *Gonioceras wulffi* is characterized by low median lobes and saddles and wide median core with closely spaced septa.

Types. Hypotypes, GSC 113645, 113651, 113652, GSC loc. O-104197 and O-104190 (Hone River), O-104530 (Jordan River), unfigured hypotypes GSC 42992, Frobisher Bay Formation, GSC loc. 69491 (northwest of Amadjuak Lake), and GSC 42990, 42993, Frobisher Bay Formation, GSC loc. 89833, 89830 (Quilliam Bay and Hall Beach, Melville Peninsula).

Gonioceras holtedahli Troedsson, 1926

Plate 27, figures 6, 9

Gonioceras holtedahli TROEDSSON, 1926, p. 83-85, Pl. 48, fig. 1, 2; Pl. 49, fig. 1; Pl. 50, fig. 1.
Gonioceras holtedahli Troedsson. BOLTON, 1977, p. 33, Pl. 12, fig. 6.

Description. Dorsoventrally compressed incomplete phragmocone, ventral side very gently arched, 60 mm long with ten camerae, median lobe diameter enlarging from 48 to 53.5 mm; septa deeply concave, 6.5 mm apart; high, strong lateral saddles with lateral ends strongly deflected backward; centrally located siphuncle large at apical end with a diameter of 15 mm decreasing to 9.2 mm at anterior end.

Type. Hypotype, GSC 113654, Frobisher Bay Formation, GSC loc. O-104190 (Hone River).

Gonioceras groenlandicum Troedsson, 1926

Plate 28, figures 1, 2, 7

Gonioceras groenlandicum TROEDSSON, 1926, p. 86-88, Pl. 48, fig. 3; Pl. 53, fig. 1, 2; Pl. 54, fig. 1; Pl. 65.

Description. Two incomplete dorsoventrally compressed phragmocones, ventral side gently convex; the most complete and largest (GSC 113659) is at least 148 mm long with 25 camerae, septa of medium convexity, 5.2 mm apart; median lobe enlarges from 36.5 mm to 55 mm diameter and

11 camerae per diameter; wide lateral saddles gently convex with lateral ends deflected obliquely backward; slightly off-center siphuncle expands from 13 to 16.7 mm diameter.

A second specimen (GSC 113658) is 60 mm long with nine camerae, septa 5.5 mm apart; median lobe with a diameter of at least 62 mm; large siphuncle 19 mm in diameter. A well preserved specimen from eastern Ellesmere Island (GSC 113799), 75 mm long with 23 camerae, septa of medium convexity, 4 mm apart, a median lobe enlarging from 32.7 to 43 mm diameter and gently convex saddles, displays a siphuncle in contact with the ventral wall at the apical end but away from the wall at the anterior end, enlarging from 11.2 mm lateral diameter to 12.2 mm.

Discussion. The more oblique direction of the lateral ends of the saddles and a broader central core distinguishes this species. There is a very close similarity between *G. groenlandicum* Troedsson and *G. anceps* Hall (unfigured hypotype GSC 113822) from the Middle Ordovician Rocklandian Cloche Island beds (Bobcaygeon Formation) of Ontario (GSC loc. 27805).

Types. Hypotypes, GSC 113658, 113659, Frobisher Bay Formation, GSC loc. O-104499 (both Sylvia Grinnell Lake); hypotype, GSC 113799, Cornwallis Formation, GSC loc. 47670 (Ellesmere Island); unfigured hypotype, GSC 42989, Frobisher Bay Formation, GSC loc. 89833 (Quilliam Bay, Melville Peninsula), unfigured hypotype GSC 113822, Bobcaygeon Formation, GSC loc. 27805 (central Ontario).

Gonioceras sp. cf. *G. angulatum* Troedsson, 1926

Plate 28, figures 8, 12

Gonioceras sp. cf. *G. angulatum* TROEDSSON, 1926, p. 89, Pl. 53, fig. 3, 4.

Description. Dorsoventrally compressed phragmocone, venter nearly flat, dorsum strongly arched, 90 mm long with sixteen camerae, gently curving septa 6 mm apart; median lobe enlarges from 38 to 58 mm diameter with nine camerae per diameter; saddles narrow with lateral ends oblique; siphuncle off-center, enlarging from 9 mm at adapical end located near ventral wall to 18 mm and closer to the strongly arched dorsal wall at anterior end.

Discussion. The species is characterized by its narrow acute saddles and shallow septa.

Type. Figured specimen, GSC 113661, Frobisher Bay Formation, GSC loc. O-104499 (Sylvia Grinnell Lake).

Genus *Lambeoceras* Foerste, 1917

Type species. *Gonioceras lambii* Whiteaves, 1891.

Lambeoceras magnum Troedsson, 1926

Plate 34, figure 1

Lambeoceras magnum TROEDSSON, 1926, p. 48, 49, Pl. 23, fig. 1, 2.
Lambeoceras sp. cf. *L. magnum* Troedsson. BOLTON, 1977, p. 34, Pl. 15, fig. 5.

Description. Incomplete phragmocone 133 mm long with 17 camerae and a diameter enlarging from 105 mm with 13 camerae per diameter to 130 mm with 15 camerae per diameter; sutures strongly concave, 9 mm apart; circular siphuncle at least 3.5 mm in from ventral surface, 3+ mm in diameter.

Discussion. The shallow camerae differentiate this specimen from the similar-sized *L. princeps* Troedsson also described from the Cape Calhoun limestone of northwestern Greenland.

Types. Hypotype, GSC 113693, Amadjuak Formation, GSC loc. 104189 (Hone River), Baffin Island; unfigured hypotype, GSC 43012, Amadjuak Formation, GSC loc. 90544 (Hall Lake, Melville Peninsula).

Order Orthocerida Kuhn

Genus *Narthecoceras* Hyatt, 1895

Type species. *Endoceras crassisiphonatum* Whiteaves, 1897.

Narthecoceras sinclairi Flower, 1968

Plate 23, figures 16, 17; Plate 32, figures 1, 2, 5

Narthecoceras sinclairi FLOWER, 1968, p. 53, Pl. 16, fig. 4–8; Pl. 18, fig. 4; Pl. 20, fig. 1–8; Pl. 21, fig. 8, 9; Pl. 22, fig. 1–3, 7, 8; Pl. 23, fig. 1–4, 11; Pl. 24, fig. 1, 2; Pl. 27, fig. 1–5; Pl. 28, fig. 1–6; Pl. 31, fig. 1, 2; Pl. 32, fig. 3, 4; Pl. 33, fig. 3–5.
Narthecoceras sinclairi Flower. BOLTON, 1977, p. 33, Pl. 12, fig. 2, 5.

Description. Siphuncle at least 175 mm long with six strong, wide, inclined septal constrictions and seven segments that enlarge from 24 to 31.2 mm diameter; endosiphuncular tube central small (2+ mm in diameter), thick endosiphocone, abundant fine radial fibres. Horizontal borings extend to endosiphocone edge.

Two large siphuncles have been collected from the Bad Cache Rapids Formation of Southampton Island. Hypotype, GSC 113808, is 270 mm long composed of seven shallow,

slightly inclined, wide septal constrictions 31 mm apart, with a maximum diameter of 41 mm, and seven and one half segments with a constant diameter of 45 mm; thick-walled polygonal endosiphuncular tube subcentral that expands from 3.7 mm to almost filling the siphuncle; abundant horizontal and vertical fine radiating fibres in vertical section.

Hypotype GSC 113809 consists of two fragments, which are assumed to be parts of the same individual. One is 125 mm long, with two, shallow, slightly inclined, wide septal constrictions about 37 mm apart, with a maximum diameter of 34 mm and three segments with a maximum diameter of 37 mm; thick-walled polygonal endosiphuncular tube subcentral; abundant horizontal fine fibres and wide endosiphocone of vertical fibres in vertical section. A second badly weathered piece is 140 mm long with three slender septal constrictions, four (plus) segments with a diameter of 28 mm, and abundant vertical fibres defining the endosiphocone.

Discussion. The slender, gently enlarging, long siphuncle segments again are the diagnostic feature of *N. sinclairi*. The two Southampton Island forms are larger than the Melville Peninsula–Akpatok Island siphuncles and are close to *N. inflatum* Troedsson (1926, cf. Pl. 9, fig. 1), but possess shallower septal constrictions.

Types. Hypotypes, GSC 113786, 113787, Akpatok Formation, both GSC loc. O-104663, Akpatok Island; hypotypes, GSC 113808, 113809, Bad Cache Rapids Group, GSC loc. 83151 (creek 0.8 km west of Coral Harbour), and 84807 (northwest of Coral Harbour), Southampton Island.

Narthecoceras equisetum Flower, 1968

Plate 32, figure 6

Narthecoceras equisetum FLOWER, 1968, p. 63, Pl. 22, fig. 4–6; Pl. 29, fig. 1–9.

Description. Very slender siphuncle 140 mm long with six slightly concave, inclined septal constrictions 17 mm apart, best displayed on weathered surface, and seven segments that enlarge from 18.7 to 26 mm diameter; small, centrally located endosiphuncular tube, pentagonal in outline, with fairly strong radial and concentric fibres.

Discussion. The slender Southampton Island specimen and the type specimens from the early Late Ordovician Farr Formation, Haileybury, Ontario, are well matched.

Type. Hypotype, GSC 113810, Bad Cache Rapids Group, GSC loc. 83151 (creek 0.8 km west of Coral Harbour, Southampton Island).

Genus Farroceras Flower 1957

Farroceras freucheni (Teichert, 1937)

Plate 32, figure 3

Calhounoceras freucheni TEICHERT, 1937, p. 99, Pl. 18, fig. 1, 2. [includes synonymy]

Description. Incomplete annulated sipuncle 75 mm long with 3+ segments, diameter at annulations 28.7 mm, annulation crests at least 28.7 mm apart, minimum diameter between annulations 25 mm; suggestion of strong radiating fibres.

Discussion. The annulations are slightly farther apart than in the type specimen from the Amadjuak Formation on Igloolik Island, Melville Peninsula. The curvature of the siphuncles between annulations is deeper than in *Farroceras*(?) *winnipegense* Flower from the Red River Formation of southern Manitoba but the spacing is similar as is the inclination of the annulations.

The Baffin Island specimen closely resembles the specimen figured as *Calhounoceras* cf. *candelabrum* Troedsson from the Red River Formation of southern Manitoba (Foerste, 1929, p. 191, Pl. 25, fig. 4).

Type. Hypotype, GSC 113686, Amadjuak Formation, GSC loc. O-104194 (Putnam Highland).

Genus *Ephippiorthoceras* Foerste, 1924

Type species. *Orthoceras formosum* Billings, 1857.

Ephippiorthoceras sp. cf. *E. compressum* Foerste, 1928b

Plate 40, figures 8, 9

cf. *Ephippiorthoceras compressum* FOERSTE, 1928b, p. 12, 23, 24, Pl. 7, fig. 9; Pl. 23, fig. 6.
cf. *Ephippiorthoceras compressum* Foerste. MILLER et al., 1954, p. 53, 54, Pl. 45, fig. 12
cf. *Ephippiorthoceras compressum* Foerste. BOLTON, 1977, p. 34, Pl. 16, fig. 8.

Description. Straight phragmocone strongly depressed laterally, 103 mm long with 15 camerae, five and one half to six per diameter, enlarging in diameter from 34 to 40 mm; shallow lateral suture lobes and low ventral–dorsal saddles; shallow septa 7.3 mm apart; siphuncle uncertain.

Discussion. The new specimen from Baffin Island is laterally compressed like the type of *E. compressum*, but it is larger in diameter, more the size of *E. dowlingi* Foerste and Savage, a species from the Amadjuak Formation.

Type. Hypotype, GCS 113767, Frobisher Bay Formation, GSC loc. O-104530 (Jordan River).

Genus *Gorbyoceras* Shimizu and Obata, 1935

Type species. *Orthoceras gorbyi* Miller, 1894, p. 322.

Gorbyoceras sp. cf. *G. geronticum*
(Foerste and Savage, 1927)

Plate 29, figures 2, 7–9

cf. *Spyroceras geronticum* FOERSTE and SAVAGE, 1927, p. 38, 39, Pl. 5, fig. 2, 3; text-fig. 1A, B.
Gorbyoceras sp. cf. *G. geronticum* (Foerste and Savage). MILLER and YOUNGQUIST, 1947, p. 14, 15, Pl. 8, fig. 1–3.

Description. Phragmocones slightly curved, ranging from 95 mm long with 16 annulations, enlarging from 22 to 25 mm, to 117 mm long with 21 annulations, enlarging from 22 to 28 mm; slightly depressed dorsoventrally, usually four annulations to four and one half camerae per diameter, becoming slightly more widely spaced in the upper half of the phragmocone; sutures straight; siphuncle circular, 3 mm in diameter, near centrally located; faint trace of longitudinal markings.

Discussion. The Baffin Island specimens are very close to the type of *G. geronticum* from the Upper Ordovician Shamattawa limestone of Shamattawa River, northern Manitoba, differing in their smaller diameter and fewer camerae per lateral diameter length. Their larger dimensions and less sloping annulations differentiate them from *G. baffinense* (Schuchert) from Melville Peninsula (Bolton, 1977).

Types. Figured specimens, GSC 113670–113673, Frobisher Bay Formation, GSC loc. O-104190 (Hone River), O-104497 and O-104208 (both Sylvia Grinnell Lake).

Gorbyoceras sp.

Plate 39, figures 2, 3

Description. Two slightly curved phragmocones: one is 280 mm in length with thirty-two annulations, enlarging from 29 to 42 mm lateral diameter, slightly depressed dorsoventrally; a second is 77 mm long at least 56 mm of which is body chamber, with 11 annulations, uncompressed, enlarging from 30 to 31 mm diameter; sutures straight; four to five annulations per diameter, wider spaced and sloping from ventral to dorsal side on the body chamber; circular siphuncle centrally located, 3.5 mm in diameter; faint coarse longitudinal markings.

Discussion. All features are larger in the Baffin Island specimens when compared with *G. baffinense* and *G. geronticum*, but smaller than with *G. giganteum* Nelson.

Types. Figured specimens, GSC 113758, 113757, Frobisher Bay Formation, GSC loc. O-104208 (Sylvia Grinnell Lake) and O-104197 (Hone River).

Order Oncocerida Flower *in* Flower and Kummel

Genus *Richardsonoceras* Foerste, 1932

Type species. *Cyrtoceras simplex* Billings, 1857.

Richardsonoceras simplex (Billings, 1857)

Plate 29, figures 1, 6

Cyrtoceras simplex BILLINGS, 1857, p. 313.

Richardsonoceras simplex (Billings). BOLTON, 1977, p. 35, 36, Pl. 16, fig. 3.

Description. Two strongly curved laterally compressed phragmocones: one 90 mm long with 25 camerae and a living chamber 35 mm long with diameters ranging from 24.4 mm dorsoventrally and 21.5 mm laterally at the base to 21.3 mm dorsoventrally and 19.4 mm laterally near the aperture; and a second, longer form 163 mm long with at least 28 camerae and a living chamber 47 mm long with diameters ranging from at least 44.4 mm dorsoventrally and 31.5 mm laterally at the base of the living chamber to 40 mm dorsoventrally and 22 m laterally at the aperture; sutures nearly transverse, slight ventral saddles.

Discussion. The smaller form in particular closely matches those from the Black River (Leray) beds of southern Ontario.

Types. Hypotypes, GSC 113668, 113669, Frobisher Bay Formation, GSC loc. O-104190 (Hone River) and O-104485 (Sylvia Grinnell Lake).

Genus *Diestoceras* Foerste, 1924

Type species. *Gomphoceras indianense* Miller and Faber, 1894.

Diestoceras sp.

Plate 33, figures 2, 6

Description. Specimen 56 mm long enlarging from a dorsoventral diameter of about 19 mm to 45 mm at the base of the living chamber 36 mm up, 13 narrow camerae each 3 mm high; narrowing living chamber 20 mm high; septa transverse.

Discussion. Specimen is larger than *D. schucherti* Foerste from the Amadjuak Formation of Silliman's Fossil Mount, closer in size to *D. staufferi* Foerste from the Richmond of Minnesota (but with narrower camerae), and finer and less obese than *D. pyriforme* Troedsson from the Cape Calhoun beds of Greenland and the Churchill River Group of Coats Island (Pl. 33, fig. 1).

Type. Figured specimen, GSC 113690, Amadjuak Formation, GSC loc. O-104540 (Jordan River).

Order Tarphycerida Flower *in* Flower and Kummel

Genus *Plectoceras* Hyatt, 1884

Type species. *Nautilus jason* Billings, 1859.

Plectoceras lowi Foerste, 1928b

Plate 34, figures 9, 10

Plectoceras lowi FOERSTE, 1928b, p. 54, Pl. 18, fig. 1; Pl. 19, fig. 1; Pl. 20, fig. 2.

Description. Closely coiled phragmocone in contact without impressed zone but slightly flattened ventral surface, over three whorls of which the last 293 mm is living chamber; maximum conch diameter 240 mm; at base of living chamber dorsoventral diameter is 57 mm and lateral diameter is 51 mm; sutures well developed ventral and dorsal lobes; rare strong costae preserved; siphuncle exogastric near ventral wall, tubes 9 to 9.5 mm in diameter and 11 mm in length.

Discussion. The subcircular whorl outline is the characteristic feature of *P. lowi* and distinguishes this specimen from the closely related dorsally impressed *Chidleyenoceras chidleyense* Foerste.

Type. Hypotype, GCS 113694, Frobisher Bay Formation, GSC loc. O-104197 (Hone River).

Genus *Apsidoceras* Hyatt, 1884

Type species. *Gyroceras* (*Lituites*) *magnificum* Billings, 1857.

Apsidoceras elegans Troedsson, 1929

Plate 33, figure 3

Apsidoceras elegans TROEDSSON, 1926, p. 38, 39, Pl. 13, fig. 2, 3; Pl. 14, fig. 2, 3; Pl. 15; Pl. 16.

Description. The Coats Island half phragmocone is strongly curved, preserving 22 camerae in 240 mm length; whorl outline subtriangular with a dorsoventral diameter enlarging from 29.2 mm to 49.6 mm and four and one half camerae per diameter.

Discussion. As with the type specimen from the Cape Calhoun beds of northwestern Greenland, the venter is more rounded than in such younger species as *A. depressum* Cooper from the Whitehead Formation of Gaspésie, Quebec (unfigured hypotypes GSC 113813, Grand Coupe, GSC loc. 27910, and GSC 113814, Cote des Irlandais, no locality number given) or *A.* sp. from the Cornwallis Formation of Canyon Fiord, Ellesmere Island (unfigured specimen, GSC 113815, GSC loc. 47664). In the last specimen, the venter is much flatter and the lateral profile more angulate thus producing a more elliptical outline.

Type. Hypotype, GSC 113812, Churchill River Group, GSC loc. 85468 (Coats Island).

Apsidoceras sp.

Plate 33, figure 5

Description. The Baffin Island specimen is half of a gently curved phragmocone preserving nine camerae in 109.3 mm, with a dorsoventral diameter of 43 mm at the apical end, enlarging to 52 mm, then narrowing to 48.3 mm at the base of the living chamber; three to four camerae per diameter; living chamber narrows to 44.2 mm dorsoventrally at aperture end in 86.4 mm length; phragmocone whorl outline subtriangular with rounded dorsum and a moderately flattened venter, whereas the living chamber is more oval; sutures form broad, shallow, ventral lobes.

Discussion. This specimen is closest to *A. elegans*, from which it differs in posessing wider spaced camerae and less curvature. It is larger than *A. boreale* Foerste and Savage from the Shamattawa limestone and the Churchill River Group of northeastern Manitoba.

Type. Figured specimen, GSC 113692, Amadjuak Formation, GSC loc. O-104202 (Amadjuak Lake); unfigured specimen GSC 113814, Cornwallis Formation, GSC loc. 47664 (Canyon Fiord, Ellesmere Island).

Class Trilobita Walch

Order Ptychopariida Swinnerton

Family Olenidae Burmeister

Genus *Triarthrus* Green, 1832

Type species. *Triarthrus Beckii* Green, 1832.

Discussion. Ludvigsen and Tuffnell (1994) refined *Triarthrus* (*Triarthrus*) to include *T. beckii* Green, *T. eatoni* (Hall), *T. rougensis* Parks, and *T. spinosus* Billings; and *T.* (*Danarcus*) to include *T. glaber* Billings and *T. canadensis* Smith. The genus ranges in age in eastern North America from Middle Ordovician Franklinian–Chatfieldian to Upper Ordovician Maysvillian or early Richmondian.

Triarthrus (*Triarthrus*) *eatoni* (Hall, 1838)

Plate 37, figures 7, 10, 11, 13-19, 21, 22

Paradoxides eatoni HALL, 1838, p. 142, Fig. 2.
Triarthrus (*Triarthrus*) *eatoni* (Hall). LUDVIGSEN and TUFFNELL, 1994, p. 195, 204, Pl. 1, fig. C-J, Pl. 3, fig. H; text-fig. 15 (for complete synonomy).

Discussion. The majority of Baffin Island forms included in *T.* (*T.*) *eatoni* have the diagnostic long palpebral lobes located opposite the 2s glabellar furrows and a parallel-sided glabella. Some, however, have shorter palpebral lobes located higher up opposite 3p glabellar lobes, a feature more characteristic of *T.* (*T.*) *beckii* Green (Pl. 37, fig. 10, 11, 16).

Types. Hypotypes, GSC 113730–113741, bituminous beds, Amadjauk Formation, GSC loc. O-104539 (Jordan River).

Genus *Triarthrus* (*Danarcus*)
Ludvigsen and Tuffnell, 1994

Type species. *Triarthrus glaber* Billings, 1859.

Triarthrus (*Danarcus*) *glaber* Billings, 1859

Plate 37, figures 2, 3

Triarthrus glaber BILLINGS, 1859, p. 382.
Triarthrus (*Danarcus*) *glaber* Billings. LUDVIGSEN and TUFFNELL, 1994, p. 208, Pl. 4, fig. I–K; text-fig. 18 (for complete synonomy).
Triarthrus spp. BOLTON *in* WORKUM et al., 1976, Pl. 3, fig. 3, 8.

Discussion. The cranidia of *T.* (*D.*) *canadensis* and *T.* (*D.*) *glaber* are difficult to separate; the basic difference between the two species is the presence of stout genal spines on the former. The long, narrow palpebral lobes that extend from well in front of the 2s glabellar furrows only to almost opposite 1s glabellar furrows, and posterior facial sutures that curve to produce narrower, more robust shoulders, somewhat like *T.* (*T.*) *beckii*, appear to be other distinguishing features of *T.* (*D.*) *canadensis*.

The majority of the Baffin Island cranidia consist of forward tapering glabella with relatively straight front margins, characteristics of the subgenus *Danarcus*. No free cheeks were identified, but the cranidia appear closer to *T. glaber* than *T. canadensis*. In a few of the larger specimens, preservation is such that the glabella appear more barrel-like. *T. beckii* displays a barrel-shaped glabella and short palpebral lobes located opposite 3p glabellar lobes. The longer palpebral lobes on the Baffin Island forms eliminates this species. The specimens of *Triarthrus* sp. (Workum et al., 1976, Pl. 3, fig. 3, 8; herein, Pl. 37, fig. 3) from the Akpatok Island bituminous shales (Boas River Formation) were considered related to *T.* (*D.*) *glaber* by Ludvigsen and Tuffnell (1994, p. 208).

Types. Hypotypes, GSC 113726, bituminous beds, Amadjuak Formation, GSC loc. O-104539 (Jordan River); unfigured hypotype GSC 41189, Section III-15 feet (4.6 m), Boas River Formation, Akpatok Island.

Family Remopleuridiidae Hawle and Corda

Genus *Hypodicranotus* Whittington, 1952

Type species. *Remopleurides striatulus* Walcott, 1875.

Hypodicranotus sp.

Plate 25, figures 3, 4

Description. Incomplete cranidia with long, narrow palpebral lobes, widest at posterior end, and long, broad, downturned glabellar tongues; interior margins fairly straight; glabella smooth, lacking lateral furrows; occipital rings continuous into posterior area of fixed cheek, lacking axial furrow.

Discussion. An incomplete hypostome from Silliman's Fossil Mount was described by Roy (1941, p. 155) as *Remopleurides* sp. This long "tuning fork" hypostome was reassigned by Ludvigsen and Chatterton (1991, p. 617) to *Hypodicranotus*.

Separation of the cranidia of these two genera is difficult, but the nature of the posterior area of the fixed cheek (Whittington, 1959, fig. 6A) has been used. In *Remopleurides*, this area is a laterally directed rod isolated by the axial furrow (Chatterton and Ludvigsen, 1976, Pl. 1, fig. 2, 5, 10, 20), whereas in *Hypodicranotus* this area is distinctly a triangular extension of the occipital ring (Whittington, 1952, Pl. 1, fig. 1). The latter description fits the cranidia described herein. They certainly are allied to *H. striatulus* that is widespread throughout the Trentonian or Franklinian and Edenian of New York State and Ontario

(Ludvigsen and Chatterton, 1991, p. 617; herein, Pl. 25, fig. 6), Manicouagan outlier and Lac Saint-Jean region of Quebec (Desbiens and Lespérance, 1989, Fig. 2, fig. A, B; Lespérance and Desbiens, 1995, fig. 3.1–3.5), as well as in the Whittaker Formation of the District of Mackenzie (Edenian *Ceraurus mackenziensis* Zone, Mitchell and Sweet, 1989).

Types. Figured specimens, GSC 113636, 113637, Amadjuak Formation, GSC loc. O-104517 and O-104516 (both Silliman's Fossil Mount).

Family Asaphidae Burmeister

Genus *Pseudogygites* Kobayashi, 1934

Type species. *Asaphus*? *latimarginata* Hall, 1847.

Pseudogygites arcticus Ludvigsen, 1979

Plate 38, figures 7, 9–11, 14, 16–18; Plate 40, figures 3–6

Pseudogygites arcticus LUDVIGSEN, 1979, p. 21, fig. 8A, 9A–H, 10B–D.

Discussion. Ludvigsen (1979) redescribed *Pseudogygites latimarginatus* (Hall) from southern Ontario (cf. Pl. 40, fig. 1, 2) and erected three new species: *P. hudsoni* Ludvigsen from the Boas River shale (= Boas River Formation), Southampton Island (Pl. 38, fig. 15; Pl. 40, fig. 7), *P. akpatokensis* Ludvigsen from the bituminous limestone unit (= Boas River Formation) of Akpatok Island (Pl. 38, fig. 13) and *P. arcticus* Ludvigsen from the Cape Phillips Formation on Devon, Cornwallis (Pl. 38, fig. 9), and Bathurst islands. In collections made in 1990 by A.D. McCracken and M.J. Melchin from Truro Island, *P. arcticus* ranges from 17.8 to 39.1 m above sea level (14.35 to 35.55 m above base of member A of the Cape Phillips Formation) (Pl. 40, fig. 3–6). These beds are assigned to the Late Ordovician Ashgill *Orthograptus fastigatus* Zone (Melchin, 1987, p. 194). The four species, from south to north, range in age from mid-Edenian to early Richmondian (Ludvigsen, 1979, Fig. 11). They form part of the *Leptobolus–Triarthrus–Pseudogygites–Geisonoceras* biotope of the widespread brown to black bituminous shale and limestone lithotope.

Pygidia of *P. arcticus* are semicircular in outline, axial rings are faintly impressed on an axis that does not extend to the margin, nine or ten pleural lobes are inflated and level with the axis, pleural furrows are strong, and the lateral border is narrow. In contrast, there are at least 12 distinct axial rings present to near the tip of the axis and at least ten pleural lobes and faint pleural furrows in *P. hudsoni*, whereas *P. akpatokensis* pygidia have a narrower axis, less distinct axial and pleural lobes, and a broader border.

The Baffin Island mature specimens are closest to *P. arcticus*, although smaller pygidia are difficult to distinguish from *P. hudsoni* (Pl. 40, fig. 7). Similarly, the cranidia of both species are much alike, but a narrow glabella, slightly wider praeglabellar field and pointed tip are features common to *P. arcticus*. On the basis of associated graptolites, these southern representatives of the late Late Ordovician *P. arcticus* are early Late Ordovician (Edenian) in age.

The discovery of an extended range (Edenian to Richmondian) for *P. arcticus* as established herein prompted a review of *P. hudsoni*. The stratigraphic position of *P. hudsoni* on Southampton Island has varied considerably and is dependent upon its assignment to either the bituminous Boas River shale or the bituminous Sixteen Mile Brook shale ("Oil Shale Interval" of Nelson and Johnson, 1976), or both. Nelson and Johnson (1976) reported *Pseudogygites*-bearing beach rubble (locality N64 8A) south of Sixteen Mile Brook. They (1976) correlated this rubble with the Richmondian oil shale interval at the top of the Churchill River Group exposed upstream on Sixteen Mile Brook. In their conodont study, McCracken and Nowlan (1989) agreed with the age assignment given to the strata of the same outcrop. Heywood and Sanford (1976) located the *Pseudogygites*-bearing Boas River shale between the Bad Cache Rapids and Churchill River groups; McCracken and Nowlan (1989) regarded this shale as middle Maysvillian. The present study confirms that *P. hudsoni* is present not only in Sanford's material from the Boas River shale but also in Nelson's rubble (Fig. 3a–d). This confirmation still does not settle the argument concerning the stratigraphic source of the rubble. However, a longer range middle Maysvillian to Richmondian age for this species of *Pseudogygites* should not be ruled out.

Types. Hypotypes, GSC 113748–113753, all GSC loc. O-104539, Amadjuak Formation, bituminous beds, (Jordan River); hypotype, GSC 113820, GSC loc. 22315, Cape Phillips Formation, Little Cornwallis Island; hypotypes, GSC 113763, 113764, GSC loc. O-104985, Cape Phillips Formation, Truro Island; GSC 113765, GSC loc. O-104982, Cape Phillips Formation, Truro Island; and GSC 113766, GSC loc. O-104992, Cape Phillips Formation, Truro Island.

Family Dimeropygidae Hupé

Genus *Dimeropyge* Öpik, 1937

Type species. *Sphaerexochus minutus* Nieszkowski, 1857.

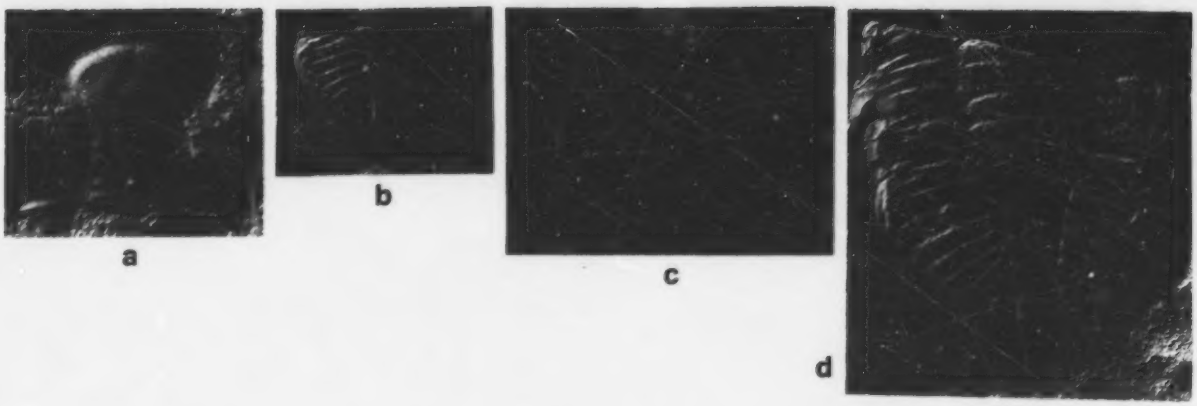

Figure 3a–d. Pseudogygites hudsoni *Ludvigsen. GSC 116160–116163, cranidium and pygidia, x3, x1, x3, x2, oil shale rubble, GSC loc. O-105251 (S.J. Nelson locality N64-8A, shore of South Bay, between 1.2 and 1.6 km (0.75–1.0 miles) south of Sixteen Mile Brook, Southampton Island).*

Dimeropyge raymondi (Roy, 1941)

Plate 26, figures 5, 8

Ischyrotoma(?) *raymondi* ROY, 1941, p. 154, Fig. 113.
Dimeropyge raymondi (Roy). WHITTINGTON, 1954, p. 145, Pl. 63, fig. 7, 8, 11.

Description. Cranidium small, strongly convex, maximum width at posterior margin 3.5 mm (tr.), length 2.5 mm (sag.); glabella ovate, width 1.6 mm (tr.), length 2.3 mm (sag.), two, short, shallow glabellar furrows perpendicular to axial furrow, third anterior furrow slight indentation only, anterior not quite overhanging a narrow preglabellar field, a deep border furrow separating this from the gently sloping upward anterior border; occipital ring distinct, 0.4 mm (sag.) wide, occipital furrow deep and steep-sided; palpebral lobes narrow.

Discussion. The Baffin Island specimen is very similar to *D. lucifer* Sinclair from the Shipshaw Formation of Lac Saint-Jean, Quebec (Sinclair, 1946, p. 858, Pl. 1, fig. 5; Desbiens and Lespérance, 1989, Fig. 2, fig. T), but the former is larger and its glabella appears more oval shaped.

Type. Hypotype, GSC 113648, Amadjuak Formation. GSC loc. O-104517 (Silliman's Fossil Mount).

Order Phacopida Salter

Family Encrinuridae Angelin

Genus *Encrinuroides* Reed, 1931

Type species. *Cybele sexcostatus* Salter, 1848.

Encrinuroides(?) sp.

Plate 28, figures 3, 4, 9; Plate 31, figure 2

Description. Three pygidia are broader than long with 16 complete axial rings plus tip, and seven pleural ribs. The smallest specimen (GSC 113684) displays small tubercules on the fifth, seventh and eighth rings.

Discussion. A poorly preserved cephalon from Baffin Island was assigned to *Encrinurus* sp. indet. by Roy (1941), to *Encrinuroides* sp. ind. by Whittington (1954) and to *Erratencrinurus* by Edgecombe and Chatterton (1990). The wide pygidia with seven pleural ribs figured herein are more suggestive of *Encrinuroides* than *Erratencrinurus* or *Encrinurus*.

Types. Figured specimens, GSC 113684, Frobisher Bay Formation, GSC loc. O-104208 (Sylvia Grinnell Lake), GSC 113662–113664, Amadjuak(?) Formation, all GSC loc. O-104480 (?talus, Sylvia Grinnell Lake).

Family Pterygometopidae Reed

Genus *Calyptaulax* Cooper, 1930

Type species. *Calyptaulax glabella* Cooper, 1930.

Calyptaulax ludvigseni n. sp.

Plate 31, figure 3; Plate 36, figures 14–18, 24;
Plate 37, figure 1

Pterygometopus ca'licephalus brevis ROY, 1941, p. 365, fig. 131a, b.
Calliops brevis (Roy). WHITTINGTON, 1954, p. 131, Pl. 60, fig. 5, 7, 8, 11, 14, 15 (for complete synonomy).

Discussion. The Baffin Island species is distinguished by its forward-expanding glabella that bear very short, deep first glabellar furrows and longer, deep, straight second and third glabellar furrows, eye lobes extending from the third glabellar furrow to the occipital furrow, and an upturned anterior margin; pygidia are convex with a pointed posterior apex, ten axial rings plus tip, and eight pleural furrows that extend to the margin. As noted by Ludvigsen and Chatterton (1982, p. 2191), the specific name *brevis* is occupied (*C. brevis* Ulrich and Delo *in* Delo). The name *C. ludvigseni* is herein proposed for the Upper Ordovician Baffin Island specimens. Roy's (1941) specimen Field Museum P28715 is herein designated as the holotype.

Types. Holotype, P28715 (see above). Hypotypes, GSC 113685 (GSC loc. O-104507), 113716 (GSC loc. O-104516), 113717, 113718 (both GSC loc. O-104517), 113719 (GSC loc. O-104198), all from the Amadjuak Formation at Silliman's Fossil Mount, and GSC 113721 (GSC loc. O-104492, Amadjuak(?) Formation, ?talus, Sylvia Grinnell Lake).

Etymology. This species is named for Rolf Ludvigsen, in appreciation of his many contributions to early Paleozoic trilobite research.

Genus *Denella* Ludvigsen and Chatterton, 1982

Type species. *Denella cumera* Ludvigsen and Chatterton, 1982.

Denella goodridgii (Schuchert, 1900)

Plate 26, figure 6; Plate 35, figure 7;
Plate 37, figures 8, 20; Plate 38, figures 1–6, 8

Dalmanites (*Pterygometopus*) *goodridgii* SCHUCHERT, 1900, p. 174, Pl. 12, fig. 5, 6.
Denella goodridgii (Schuchert). LUDVIGSEN and CHATTERTON, 1982, p. 2200, Pl. 3, fig. 2–5 (for complete synonomy).

Description. The Baffin Island specimens are characterized by fused second and third glabella lobes that form a trapezoidal lateral lobe, a wide (tr.) anterior cephalic arch, a short blunt projection in front of the glabella, and high standing palpebral lobes. At least 13 thoracic segments are preserved.

Pygidia are subtriangular, strongly convex with evenly tapering pygidial axes that do not reach the posterior margins, composed of 11 distinct axial rings plus tip with four to six indistinct, small, closely spaced rings; nine pleural ribs that extend to the margins; posterior margins pointed and upturned.

Types. Hypotypes, GSC 113649, 113744, Amadjuak Formation, both GSC loc. O-104517; hypotypes, GSC 13703, 113722, 113723, 113742, 113743, all GSC loc. O-104516 (Silliman's Fossil Mount).

Genus *Sceptaspis* Ludvigsen and Chatterton, 1982

Type species. *Pterygometopus lincolnensis* Branson, 1909.

Sceptaspis sp.

Plate 28, figures 10, 11

Description. Two triangular pygidia with narrow, evenly tapering pygidial axes that nearly reach the posterior margins, composed of 24 axial rings and an indistinctly furrowed tip or 27 rings without a tip, 12 to 14 pleural ribs that extend to the margins, posterior margin pointed.

Discussion. The large number of axial rings and pleural ribs plus the triangular shape are characteristics more of *Sceptaspis* than *Denella*.

Types. Hypotypes, GSC 113666, 113667, Amadjuak Formation, GSC loc. O-104516 and O-104517 (both Silliman's Fossil Mount).

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PLATE 1

Amadjuak Formation

Figures 1–5, 14, 15. *Fisherites arcticus* (Etheridge)

1–4. GSC 113388, basal view of a discoidal thallus showing prominent cone or central nucleus (x1/2) and variation in wall structure as exposed through weathering, ranging from four- to five-sided surface facets or plates through rhombs with septal-like structures to an open mesh system (x4), GSC loc. O-104191 (Amadjuak Lake).

5. GSC 113389, natural weathered longitudinal section showing thick pillars, upper surface below (x4), GSC loc. O-104192 (Nuvungmiut River).

14, 15. GSC 113390, surface view showing rhombic plate arrangement (x1), and natural weathered longitudinal section showing undulating discoidal form of thallus and thick pillars or merom shafts (x2), GSC loc. O-104516 (Silliman's Fossil Mount).

Figures 7, 12. Chitinozoa(?). GSC 113391, 113392, x40, GSC loc. O-104201 (Jordan River) and O-104194 (Putnam Highland).

Figure 8. Microfauna indeterminate. GSC 113393, x40, GSC loc. O-104525 (Silliman's Fossil Mount).

Figure 9. New receptaculitid genus. GSC 113394, surface view of small thallus, x2, GSC loc. O-104198 (Silliman's Fossil Mount).

Figure 10. *Fisherites fieldi* (Roy). GSC 113395, view of lower surface of conical thallus showing prominent cone or central nucleus, small plates and oval thick pillars, x1, GSC loc. O-104540 (Jordan River).

Figure 11. Microfauna indeterminate. GSC 113399, x40, GSC loc. O-104189 (Hone River).

Figure 13. Algae indeterminate. GSC 113396, longitudinal section, x40, GSC loc. O-104201 (Jordan River).

Figure 16. *Fisherites occidentalis* (Salter). GSC 113398, natural weathered longitudinal section of a discoidal thallus with very regular width pillars, x1, GSC loc. O-104189 (Hone River).

Frobisher Bay Formation

Figure 6. *Fisherites occidentalis* (Salter). GSC 113397, longitudinal thin section showing thick merom shafts or pillars (note abundant organic infilling), x4, GSC loc. O-104497 (Sylvia Grinnell Lake).

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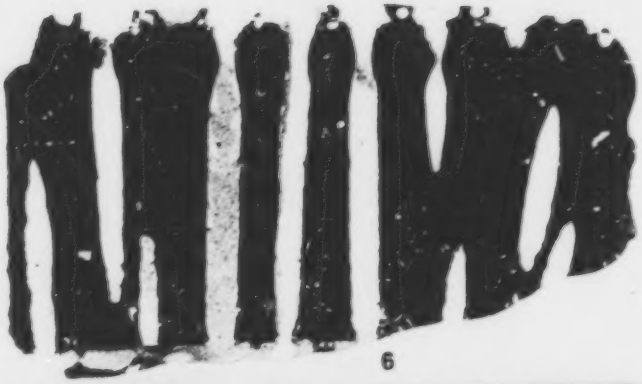
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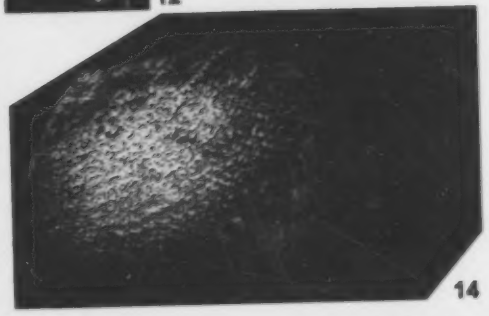
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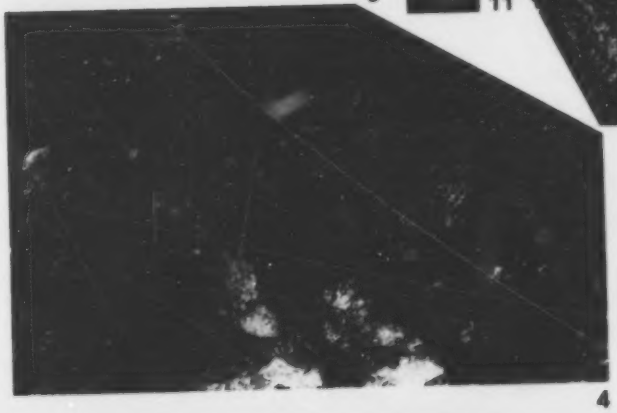
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PLATE 2

Amadjuak Formation

Figures 1–3. *Vermiporella canadensis* Horne and Johnson. GSC 113400–113402, oblique longitudinal sections, x20, all GSC loc. O-104188 (Hone River) (associated transverse section algae in fig. 2 and 3 = *Intermurella scotica* Elliott).

Figure 4. Algae indeterminate. GSC 113407, longitudinal section, x40, GSC loc. O-104201 (Jordan River).

Figure 5. Microfauna indeterminate. GSC 113408, x35, GSC loc. O-104201 (Jordan River).

Figure 6. Algae indeterminate. GSC 113404, longitudinal section, x20, GSC loc. O-104188 (Hone River).

Figure 7. *Vermiporella wesenbergensis* Moskalenko. GSC 113409, oblique longitudinal section, x10, GSC loc. 69529 (Putnam Highland).

Figure 8. *Cornulites sterlingensis* Meek and Worthen. GSC 113410, x4, attached to a small colony of *Amsassia floweri* n. sp., GSC loc. O-104526 (Silliman's Fossil Mount).

Figure 9. Sponge spicule. GSC 113411, x40, GSC loc. O-104525 (Silliman's Fossil Mount).

Figure 10. Graptolite(?). GSC 113412, x40, GSC loc. O-104525 (Silliman's Fossil Mount).

Figures 11, 12. Chitinozoa(?). GSC 113405, 113406, accumulations within lacunae of *Catenipora* sp. 4, x40, GSC loc. O-104189 (Hone River).

Figure 13. *Vermiporella canadensis* Horne and Johnson. GSC 113403, x10, oblique longitudinal section located within lacunae of *Manipora sinclairi* n. sp. (holotype, GSC 113446), GSC loc. O-104201 (Jordan River).

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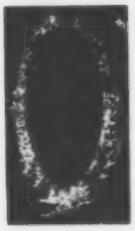
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PLATE 3

Frobisher Bay Formation

Figures 1, 8, 9. *Asteriospongia anatrope* Rigby

1. GSC 113413, vertical thin section showing large vertical canals, x10, GSC loc. O-104199 (Jordan River).

8, 9. GSC 113414, horizontal and vertical thin sections, x10, GSC loc. O-104190 (Hone River).

Figures 2–7. *Incrassospongia rhipidos* Rigby

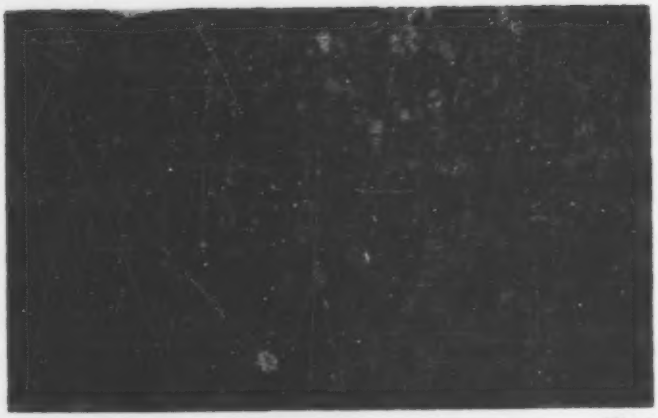
2. GSC 113415, 113415a, oblique vertical sections (uncoated), x1, GSC loc. O-104208 (Sylvia Grinnell Lake) (compare Rigby, 1977, Pl. 2, fig. 4).

3. GSC 113416, 113416a, two conical-shaped specimens, x1, GSC loc. O-104199 (Jordan River).

4. GSC 113417, weathered specimen showing horizontal and vertical structures, x2, GSC loc. O-104199 (Jordan River).

5. GSC 113418, club-shaped specimen, x1, GSC loc. O-104530 (Jordan River).

6, 7. GSC 113419, horizontal and vertical thin sections, x2, GSC loc. 69491 (northwest of Amadjuak Lake).



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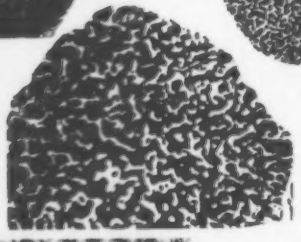

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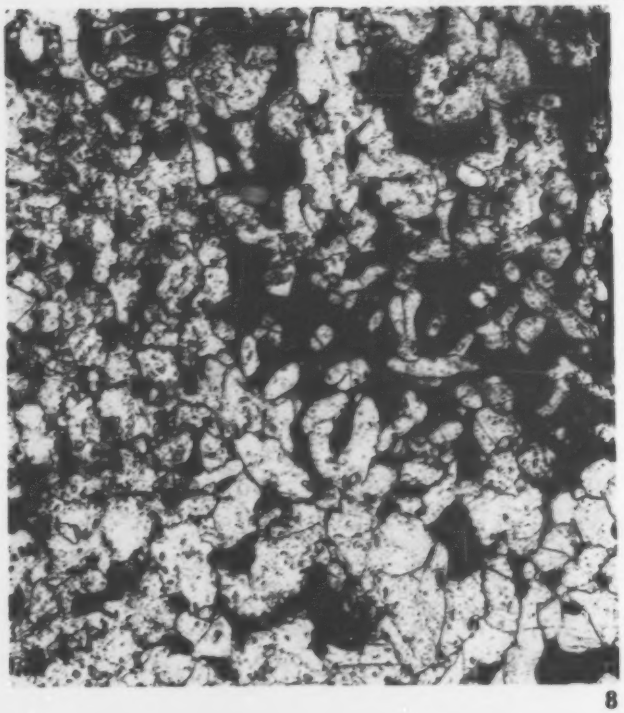

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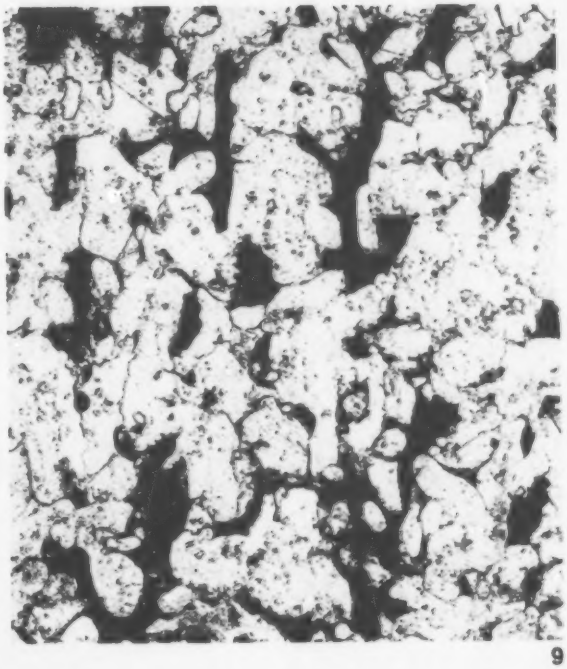

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PLATE 4

Amadjuak Formation

Figures 1, 5. *Cystostroma* sp. and *Labechia* sp. GSC 113420, 113420 a, vertical thin sections showing lower *Labechia* coenosteum in places directly overlain by *Cystostroma* coenosteum which in turn overgrows *Catenipora* corallites. Note larger cysts overiding the corals, x5, x10, GSC loc. 69529 (Putnam Highland).

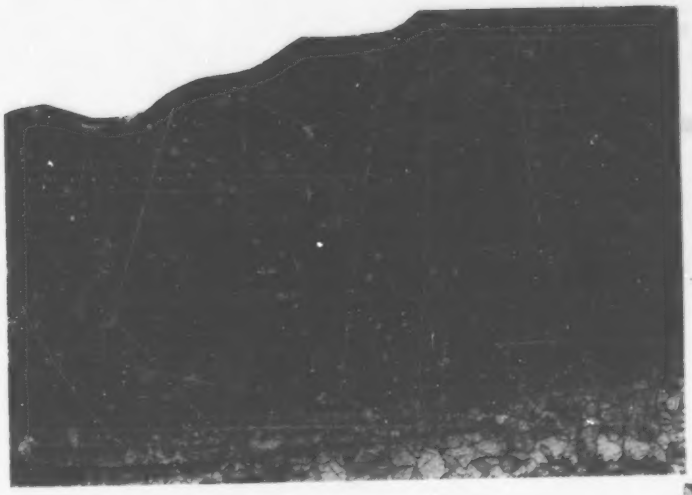
Figure 2. *Cystostroma* sp. GSC 113421, vertical thin section showing some large cysts in basal region, x5, GSC loc. O-104189 (Hone River).

Frobisher Bay Formation

Figures 3, 4, 6. *Labechia* sp.

3, 6. GSC 113422, vertical and tangential thin sections showing thick pillars with rounded ends, x20, GSC loc. O-104487 (Sylvia Grinnell Lake).

4. GSC 113423, vertical thin section showing thinner pillars, x20, GSC loc. O-104484 (Sylvia Grinnell Lake).



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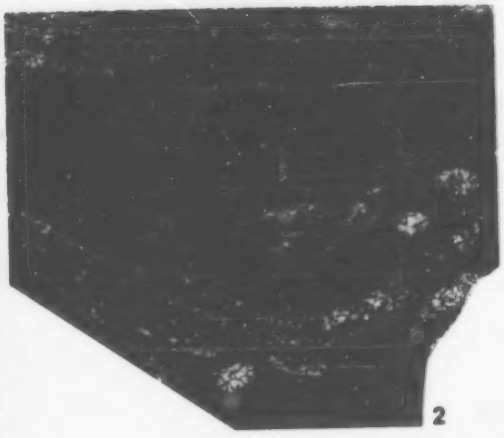

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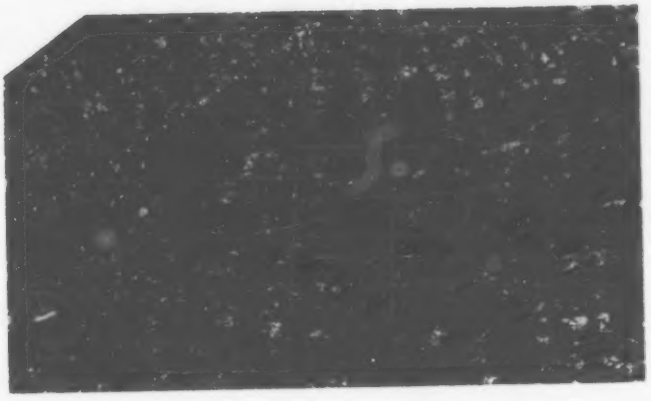

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PLATE 5

Frobisher Bay Formation

Figures 1, 6. *Nyctopora* sp. GSC 113440, transverse thin section (x10) showing short spines and corner mural pores, and longitudinal thin section (x5) showing equally spaced horizontal tabulae, GSC loc. O-104199 (Jordan River).

Figure 2. *Reuschia* sp. GSC 113441, small colony showing longitudinal and transverse sections, x2, GSC loc. O-104530 (Jordan River).

Amadjuak Formation

Figures 3, 4. *Saffordophyllum* sp. GSC 113442, transverse and longitudinal thin sections, x10, GSC loc. O-104189 (Hone River).

Figure 5. *Calapoecia arctica* Troedsson. GSC 113443, longitudinal thin section showing variation in thickness of coenenchyme, x4, GSC loc. O-104189 (Hone River).

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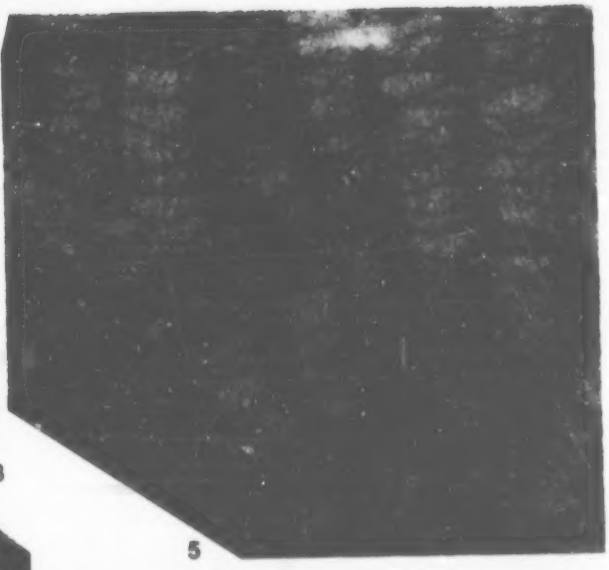

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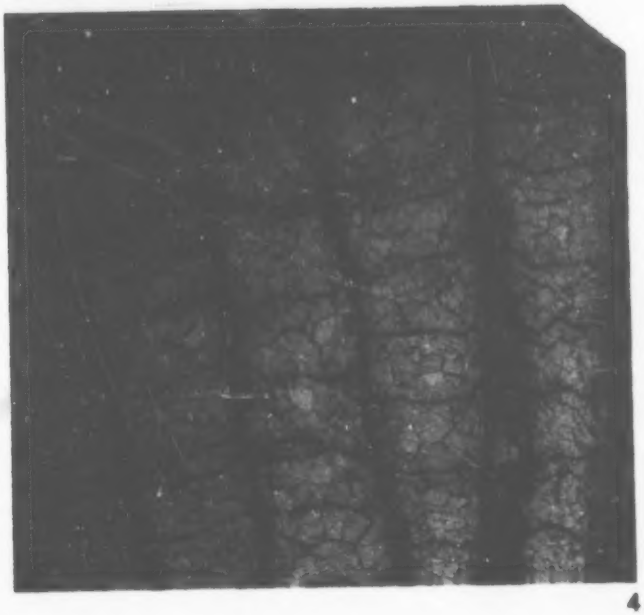

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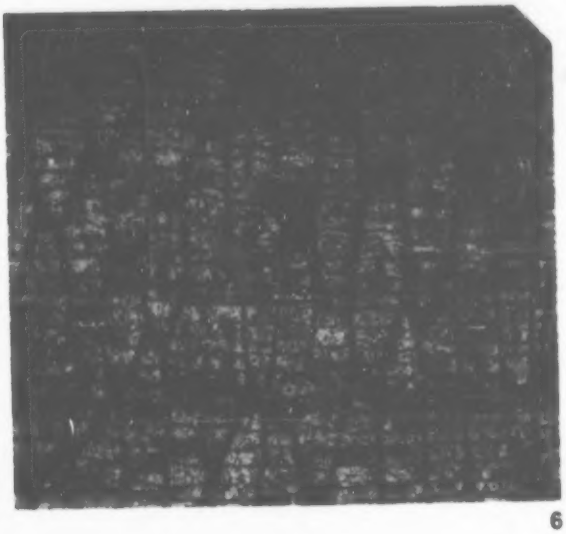

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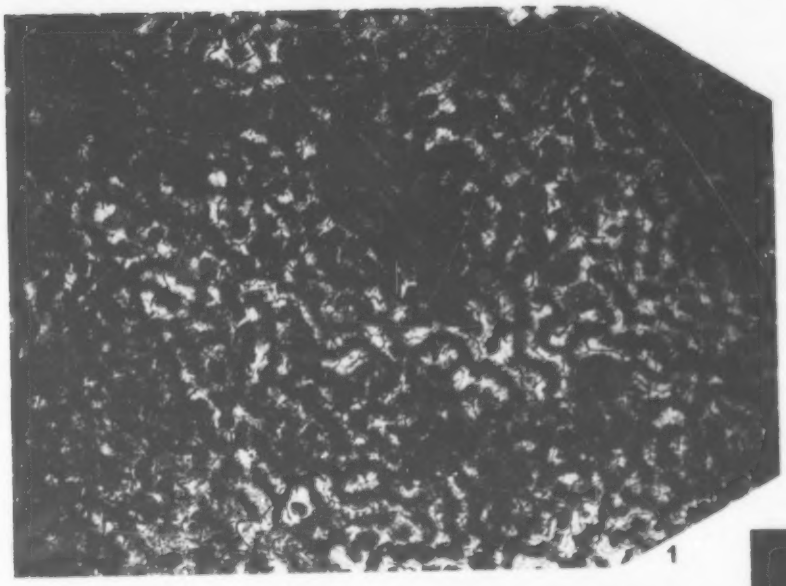
PLATE 6

Amadjuak Formation

Figures 1, 4, 6, 7. *Chaetetipora amadjuakensis* n. sp. Holotype, GSC 113425, transverse and longitudinal thin sections, x20, and surface views showing meandering nature of corallite walls, x5, GSC loc. O-104193 (unnamed lake northwest of Sylvia Grinnell Lake).

Figures 2, 3. *Palaeophyllum* sp. GSC 113476, x2, transverse and longitudinal thin sections showing short minor septa and slightly longer major septa well withdrawn from axis and downturned tabulae, GSC loc. O-104517 (Silliman's Fossil Mount).

Figure 5. *Amsassia floweri* n. sp. Paratype, GSC 113427, longitudinal thin section, x20, GSC loc. O-104517 (Silliman's Fossil Mount).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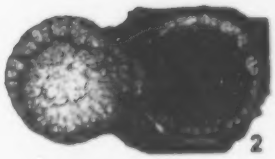
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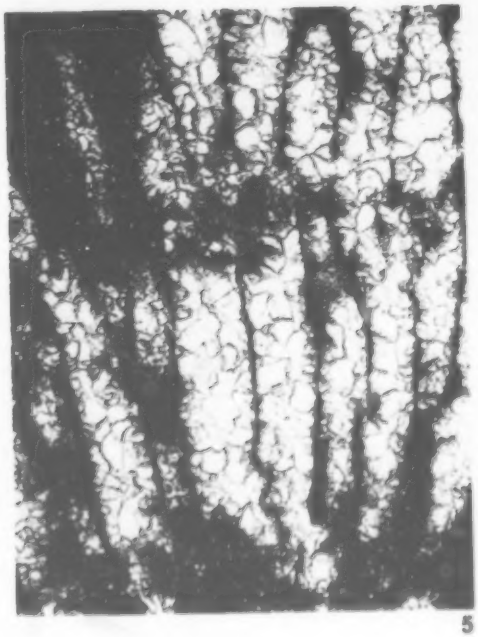
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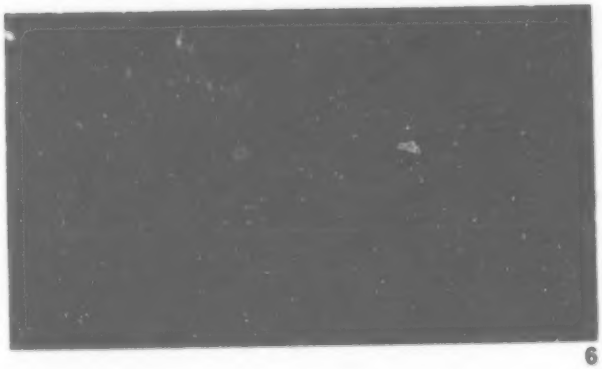
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PLATE 7

Amadjuak Formation

Figures 1–6. *Amsassia floweri* n. sp.

1, 2. Holotype, GSC 113426, transverse showing well isolated corallites and longitudinal thin sections, x20, GSC loc. O-104526 (Silliman's Fossil Mount).

3. Paratype, GSC 113428, transverse thin section showing corallites in close contact (note part of large circular boring in lower left), x40, GSC loc. O-104526 (Silliman's Fossil Mount).

4. Paratype, GSC 113429, transverse thin section displaying both isolated and close contact corallites, x20, GSC loc. O-104517 (Silliman's Fossil Mount).

5, 6. Paratype, GSC 113430, transverse showing considerable variation in corallite spacing (x20) and longitudinal (x10) thin sections, GSC loc. O-104540 (Jordan River).

Plate 7

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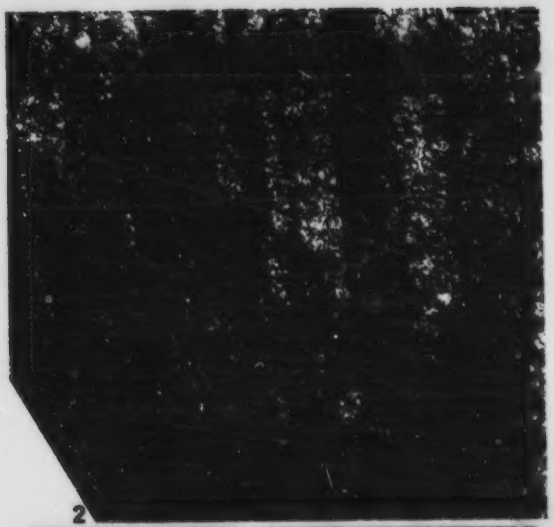

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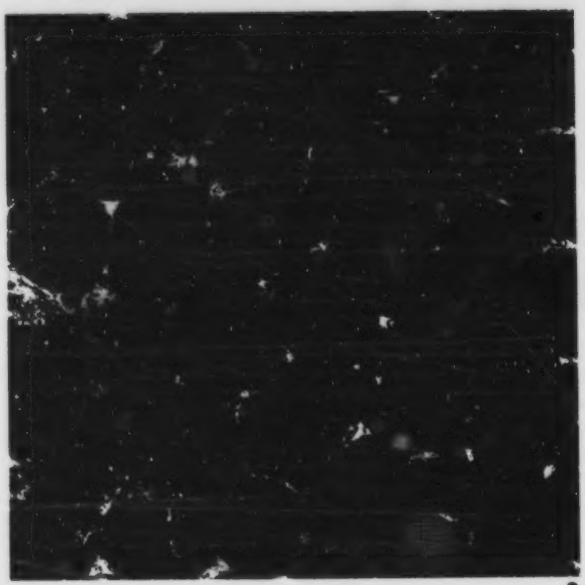

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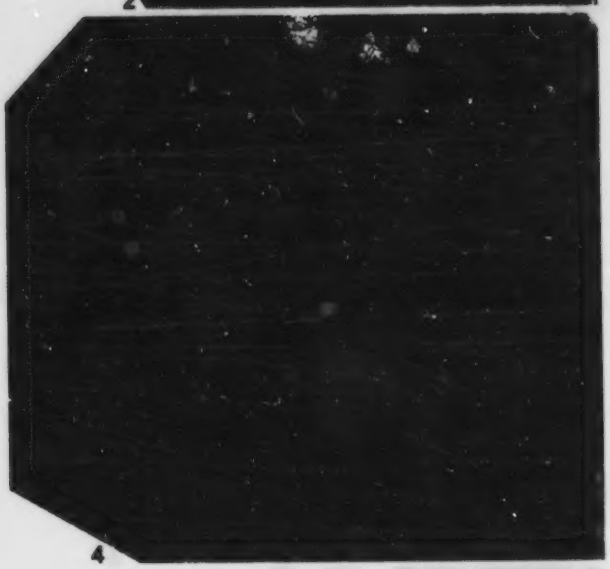

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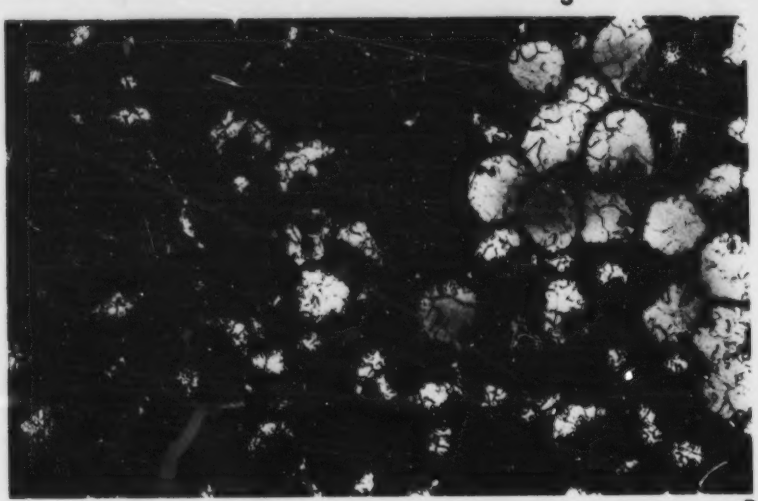

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PLATE 8

Figures 1–5. *Calapoecia ungava* Cox

Bad Cache Rapids Group

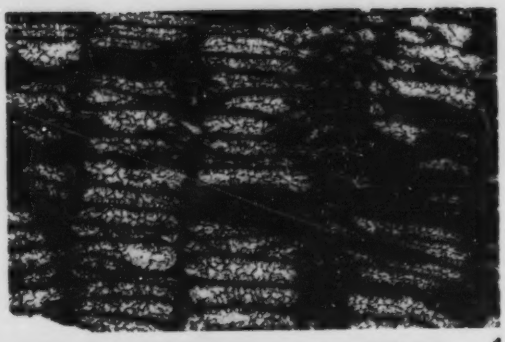
1, 2. GSC 113776, longitudinal and transverse thin sections, x4, GSC loc. 84561 (Rocky Brook, Southampton Island).

3. GSC 113777, transverse thin section, x10, GSC loc. 84625 (creek 0.8 km west of Coral Harbour, Southampton Island).

Amadjuak Formation

4, 5. GSC 113445, transverse (x10) and longitudinal (x5) thin sections, GSC loc. O-104198 (Silliman's Fossil Mount).

Figures 6, 7. *Calapoecia coxi* Bassler. GSC 113444, transverse and longitudinal thin sections, x10, GSC loc. O-104194 (Putnam Highland).



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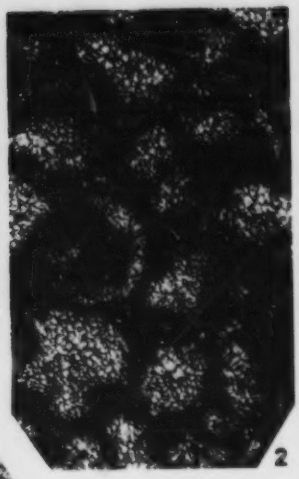

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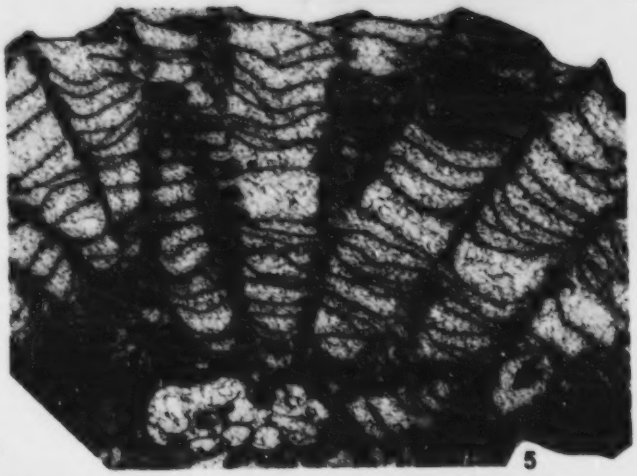

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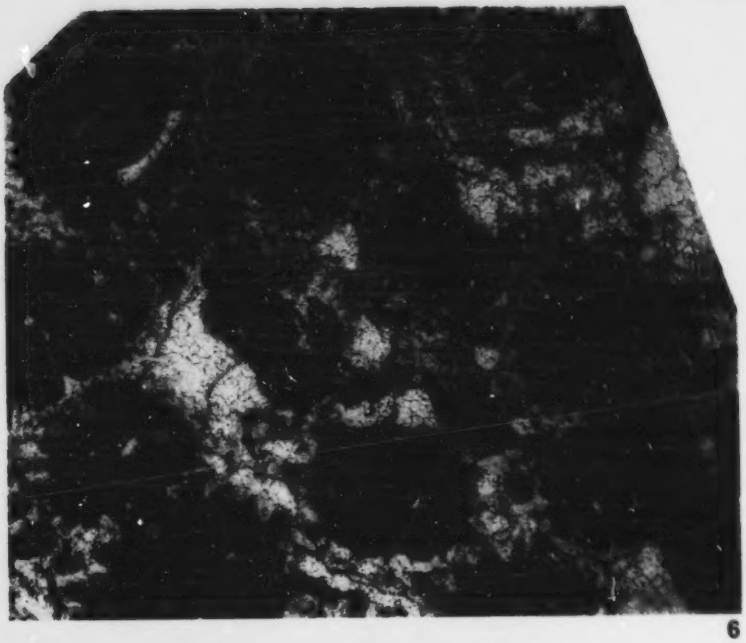

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PLATE 9

Amadjuak Formation

Figures 1–3, 5, 6. *Manipora sinclairi* n. sp.

1, 2, 6. Holotype, GSC 113446, transverse and longitudinal thin sections, x4, and longitudinal thin section showing a bud, x35, GSC loc. O-104201 (Jordan River).

3. Paratype, GSC 113447, transverse thin section, x4, GSC loc. O-104198 (Silliman's Fossil Mount).

5. Paratype, GSC 113448, transverse thin section, x10, GSC loc. O-104193 (unnamed lake, northwest of Sylvia Grinnell Lake).

Simard Formation

Figure 4. *Quepora quebecensis* (Lambe). GSC 113778, transverse thin section showing oval corallites, x10, Simard Formation, GSC loc. 101248 (Chambord, Lac Saint-Jean, Quebec).

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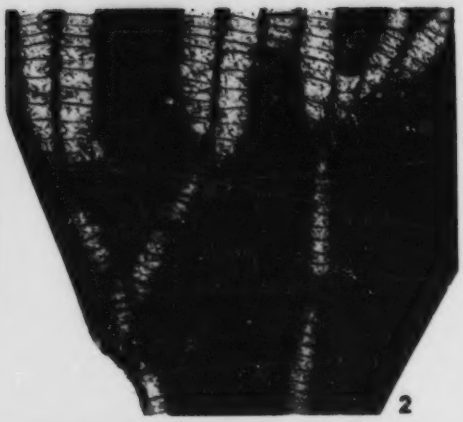

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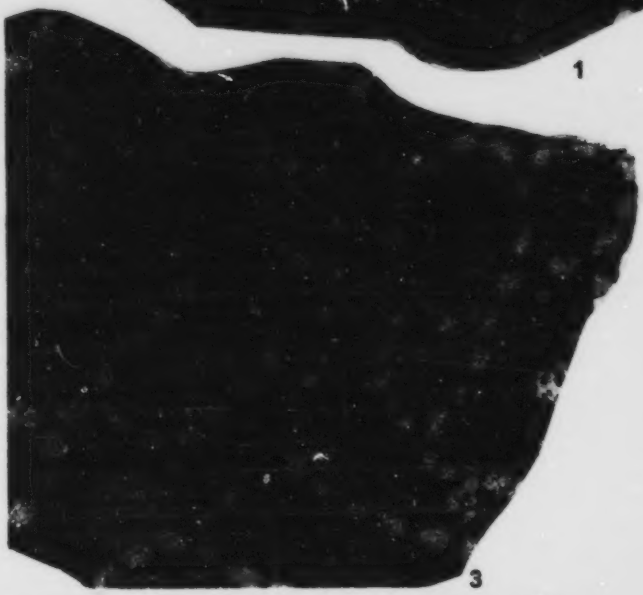

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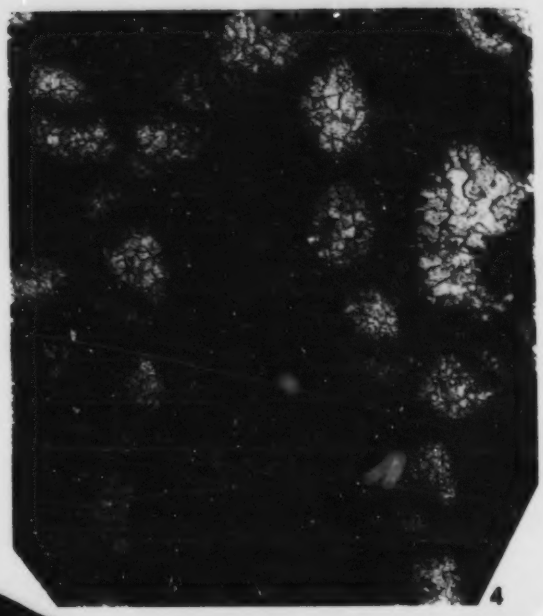

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PLATE 10

Upper Ordovician

Figures 1, 2. *Manipora irregularis* (Teichert). GSC 113779, 113823, transverse and longitudinal thin sections, x10, GSC loc. 99411 (north of Aberdeen Lake, Nunavut).

Amadjuak Formation

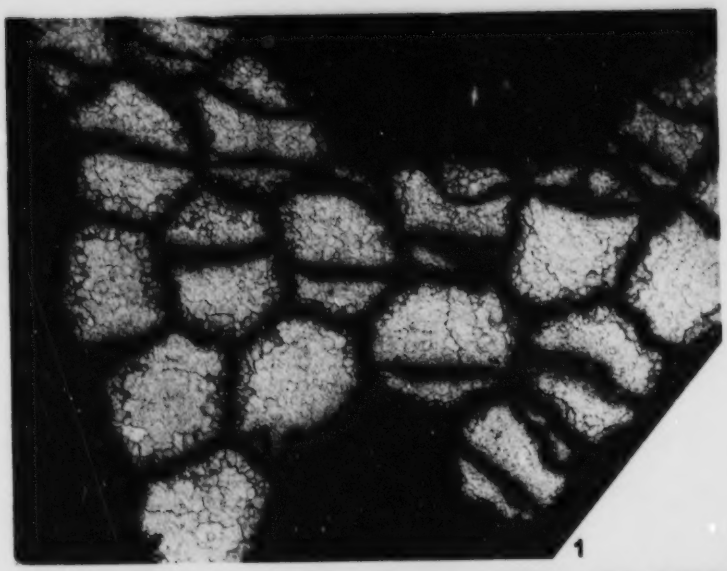
Figures 3, 4, 6. *Macleodea martini* n. sp.

3, 4. Paratype, GSC 113451, transverse (x10) and longitudinal (x4) thin sections, GSC loc. O-104198 (Silliman's Fossil Mount).

6. Paratype, GSC 113452, longitudinal thin section, x4, GSC loc. O-104507 (Silliman's Fossil Mount).

Vaureal Formation

Figure 5. *Saffordophyllum* sp. GSC 113780, transverse thin section, x10, Vaureal Formation, GSC loc. 36262 (main highway 90.1 km from Port Menier, Anticosti Island, Quebec).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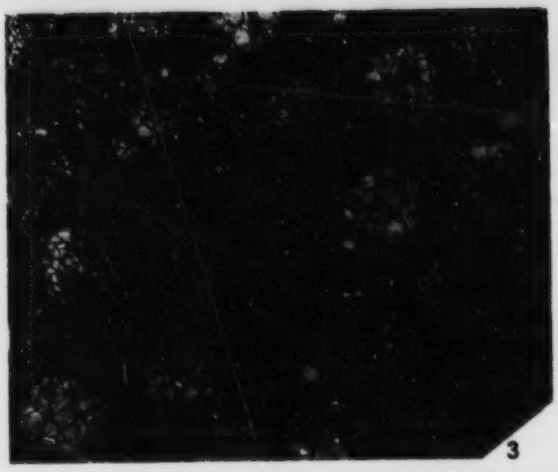
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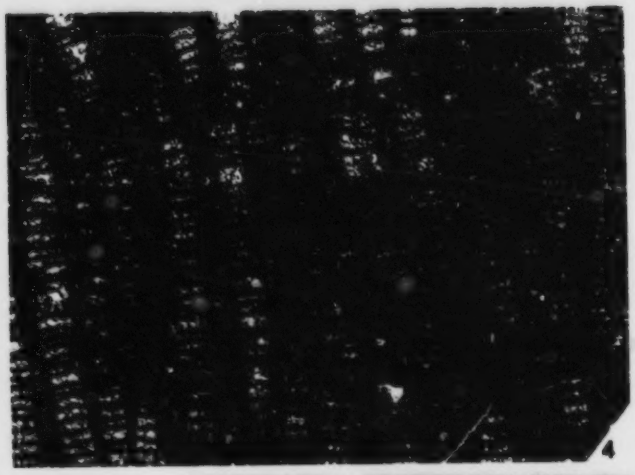
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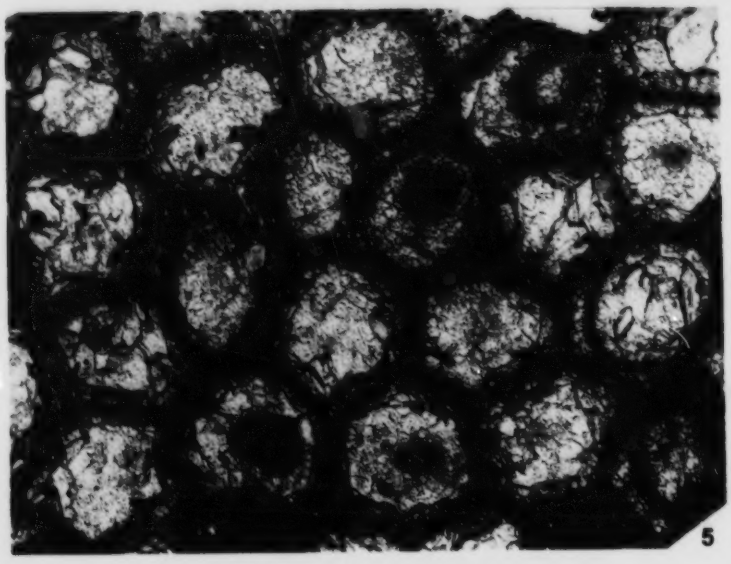
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PLATE 11

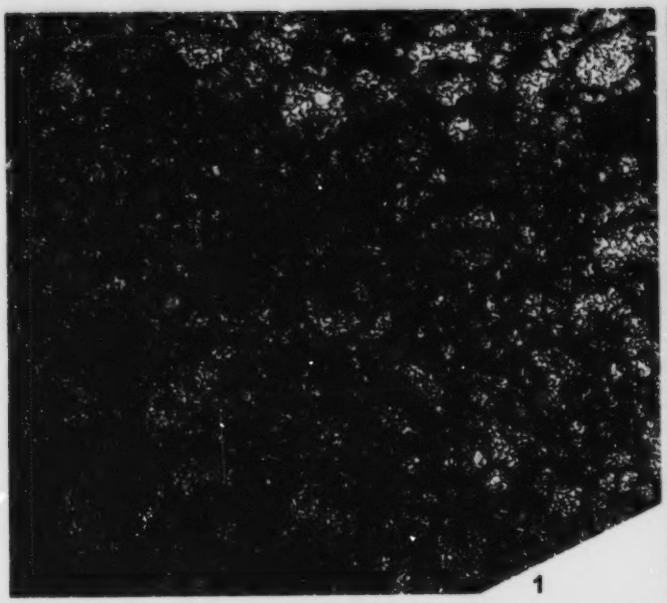
Amadjuak Formation

Figures 1–5. *Macleodea martini* n. sp.

1, 2. Paratypes, GSC 113453, 113454, transverse and longitudinal thin sections, x10, x5, GSC loc. O-104507 (Silliman's Fossil Mount).

3–5. Holotype, GSC 113450, transverse and longitudinal thin sections, x5, GSC loc. O-104198 (Silliman's Fossil Mount).

Figures 6, 7. *Cyrtophyllum lambei* (Schuchert). GSC 113457, transverse and longitudinal sections, x4, GSC loc. O-104525 (Silliman's Fossil Mount).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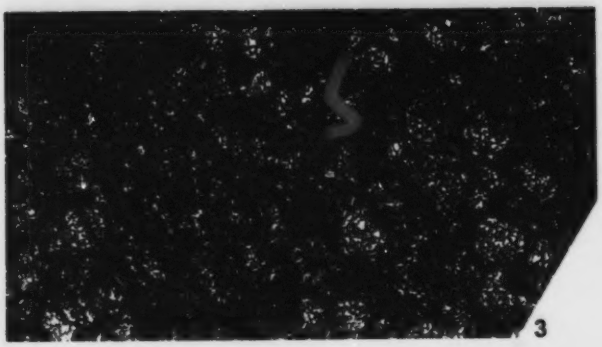
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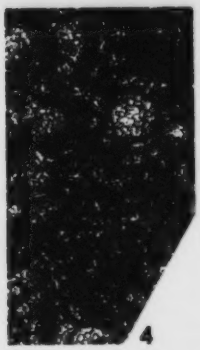
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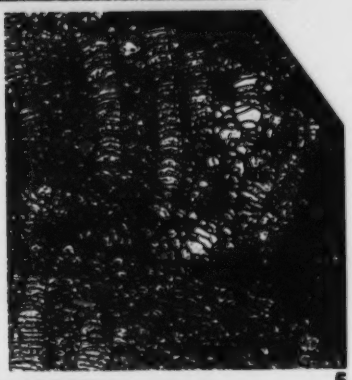
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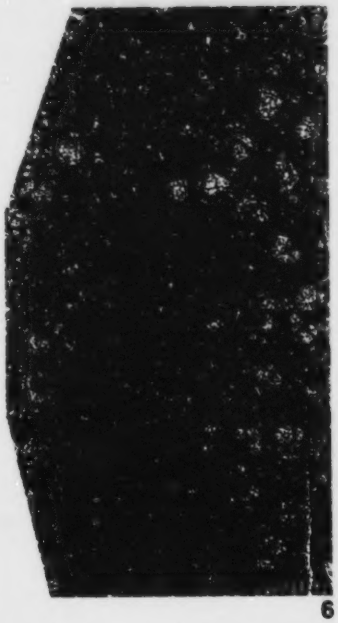
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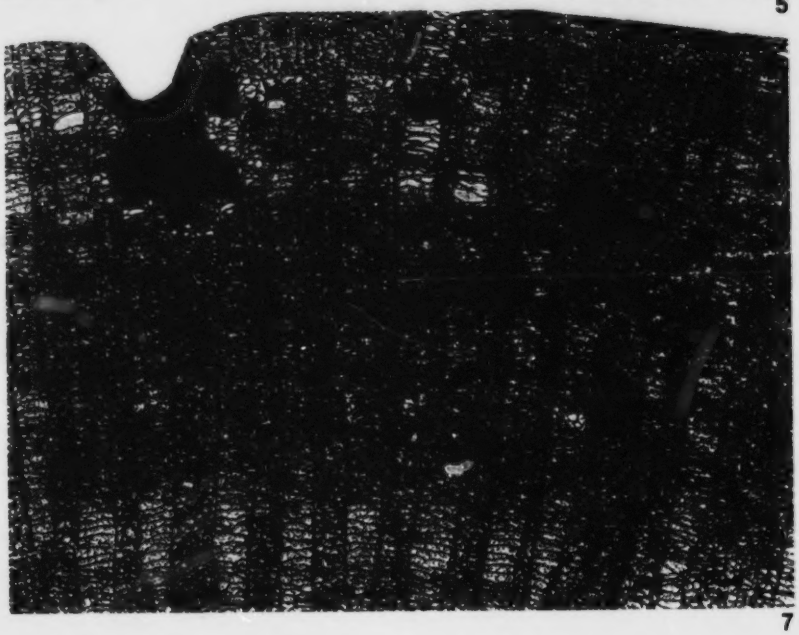
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PLATE 12

Bad Cache Rapids Group

Figures 1, 2, 4, 7. *Cyrtophyllum lambei* (Schuchert)

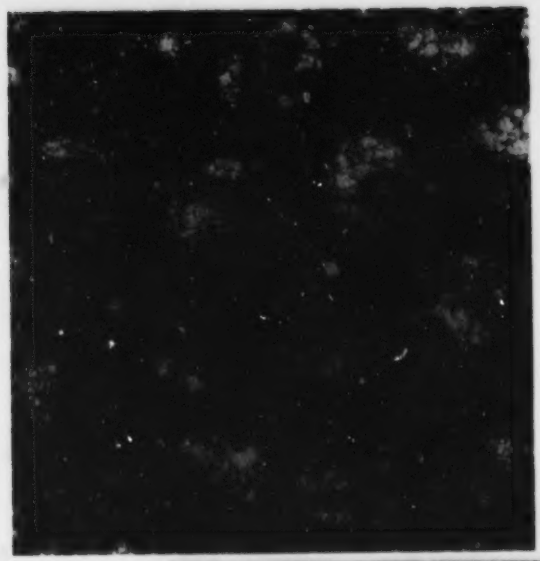
1, 2. GSC 113781, transverse and longitudinal thin sections, x10, GSC loc. 84617 (creek 0.8 km west of Coral Harbour, Southampton Island).

4, 7. GSC 113782, transverse and longitudinal thin sections, x4, GSC loc. 84561 (Rocky Brook, Southampton Island).

Amadjuak Formation

Figures 3, 5. *Cyrtophyllum pattersoni* (Roy). GSC 113459, longitudinal with short corallites in a thin corallum, and transverse thin sections, x4, GSC loc. O-104507 (Silliman's Fossil Mount).

Figure 6. *Manipora irregularis* (Teichert). GSC 113458, transverse thin section, x4, GSC loc. O-104198 (Silliman's Fossil Mount).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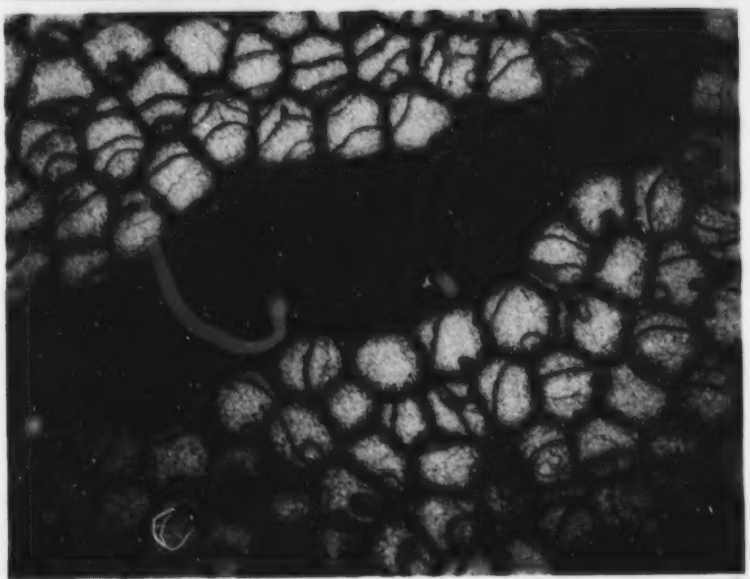
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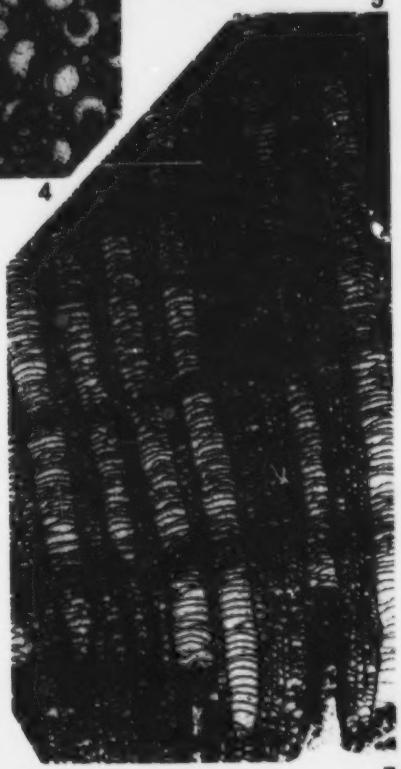
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PLATE 13

Amadjuak Formation

Figures 1, 2, 7, 8. *Cyrtophyllum pattersoni* (Roy)

1, 2. GSC 113460, transverse and longitudinal thin sections in which corallites are close, x10, GSC loc. O-104194 (Putnam Highland).

7, 8. GSC 113461, transverse cutting through a zone of crowded tabulae, and longitudinal showing wide coenenchyme, thin sections, x10, GSC loc. O-104198 (Silliman's Fossil Mount).

Frobisher Bay Formation

Figures 3–6. Echinoderm plates. GSC 113462–113465, x6 (uncoated), x2, x2, x6, GSC loc. O-104485 (fig. 3, 4, 6) and O-104208 (fig. 5) (both Sylvia Grinnell Lake).

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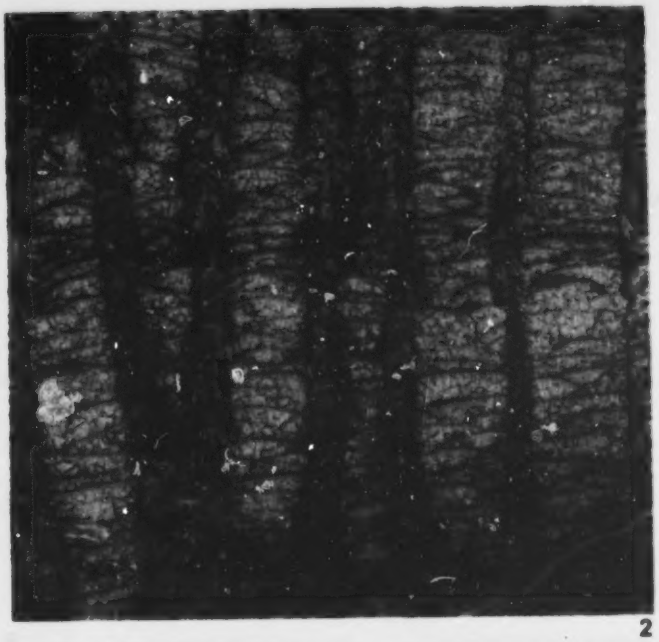
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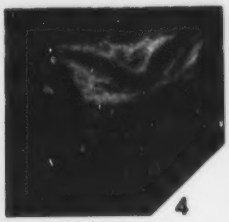
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PLATE 14

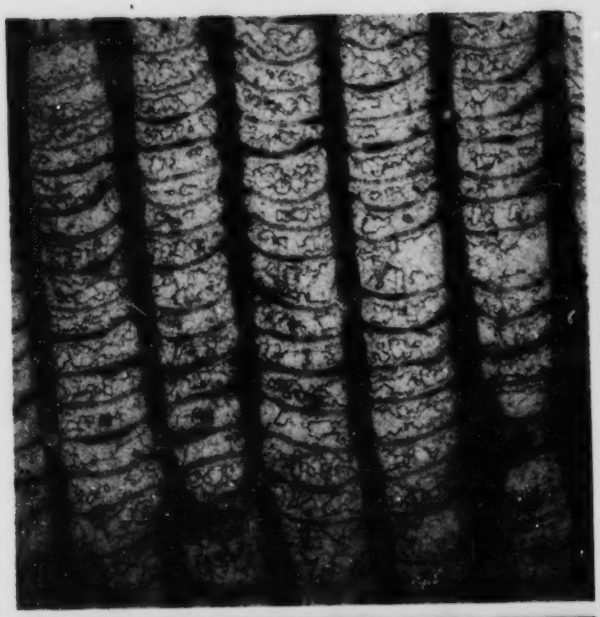
Amadjuak Formation

Figures 1, 5. *Catenipora* sp. 5. GSC 113468, longitudinal and transverse, showing elongate corallites with short spines preserved in lower rank, thin sections, x10, GSC loc. O-104188 (Hone River).

Figure 2. *Catenipora* sp. 4. GSC 113467, transverse thin section, x4, GSC loc. O-104189 (Hone River).

Figures 3, 4. *Catenipora rubra* Sinclair and Bolton. GSC 113469, transverse and longitudinal thin sections, x4, GSC loc. O-104189 (Hone River).

Figure 6. *Catenipora aequabilis* (Teichert). GSC 113466, transverse thin section, x10, GSC loc. O-104200 (Jordan River).



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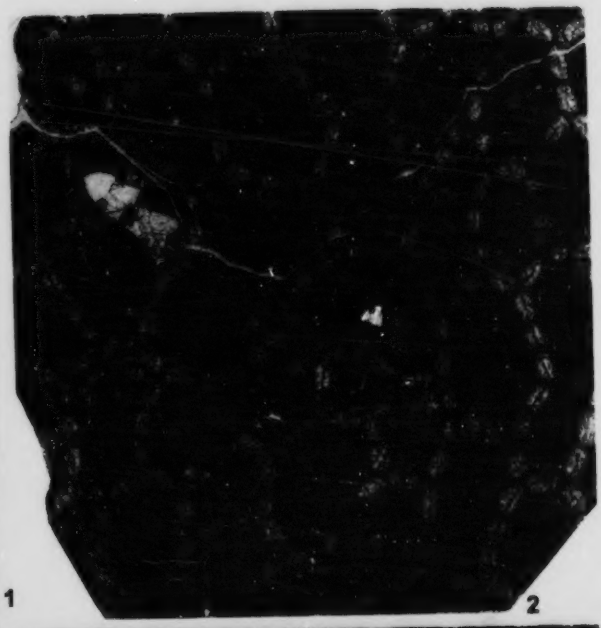

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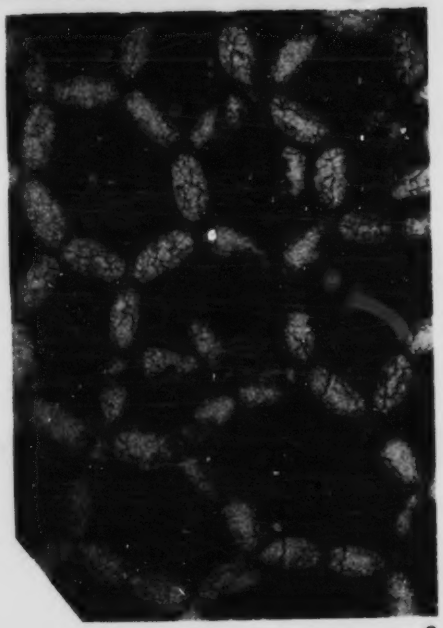

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PLATE 15

Frobisher Bay Formation

Figures 1–5. *Labyrinthites* (*Labyrinthites*) *chidlensis* Lambe

1, 2. GSC 113473, longitudinal (x20) and transverse showing local development of cerioid clusters (x10) thin sections, GSC loc. O-104208 (Sylvia Grinnell Lake).

3–5. GSC 113474, transverse and longitudinal thin sections, note lateral bud in lower left of figure 5, x10, GSC loc. O-104190 (Hone River).

Amadjuak Formation

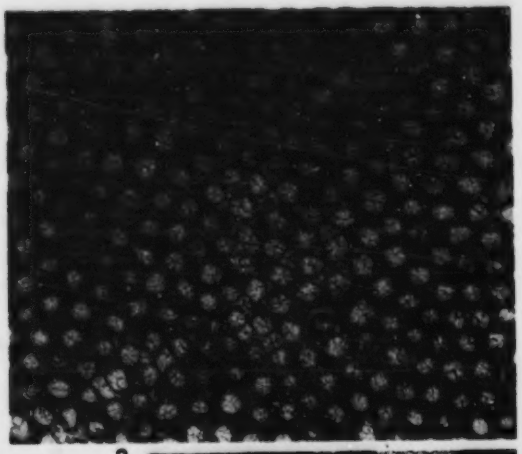
Figures 6–8. *Catenipora rubra* Sinclair and Bolton

6. GSC 113470, longitudinal thin section showing lateral or marginal increase, x10, GSC loc. O-104194 (Putnam Highland).

7. GSC 113471, transverse thin section showing typical loose, long ranks, x4, GSC loc. O-104525 (Silliman's Fossil Mount).

8. GSC 113472, longitudinal thin section showing tabularial increase and mural pores, x10, GSC loc. O-104201 (Jordan River).

1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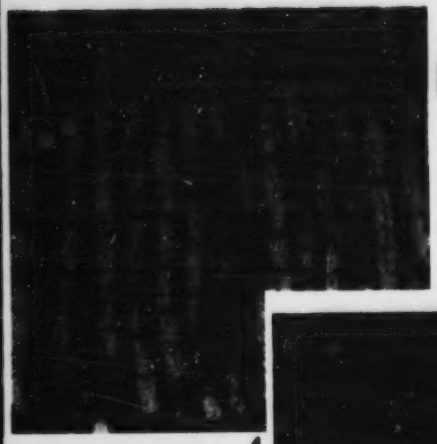
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PLATE 16

Frobisher Bay Formation

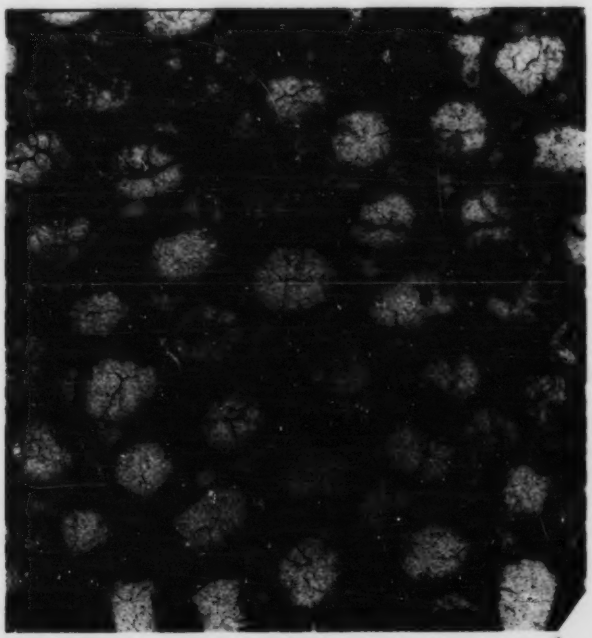
Figures 1, 2. *Labyrinthites* (*Labyrinthites*) *chidlensis* Lambe. GSC 113475, transverse and longitudinal thin sections, x40, x20, GSC loc. O-104197 (Hone River).

Amadjuak Formation

Figures 3–5. *Cupulocrinus* sp. aff. *C. minimus* Springer. GSC 113477–113479, x4, GSC loc. O-104516 (Silliman's Fossil Mount).

Figures 6, 7. *Orbignyella*(?) sp. GSC 113481, transverse and longitudinal thin sections, x40, GSC loc. O-104517 (Silliman's Fossil Mount).

Figures 8, 9. *Mesotrypa* sp. GSC 113480, longitudinal and transverse thin sections, x10, GSC loc. O-104230 (Silliman's Fossil Mount).



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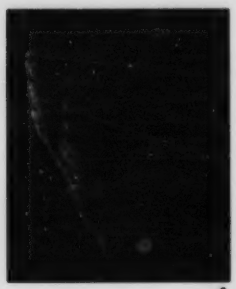

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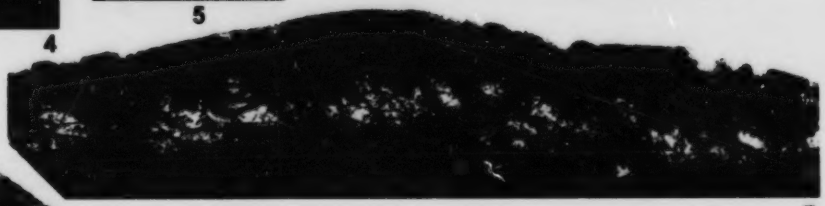

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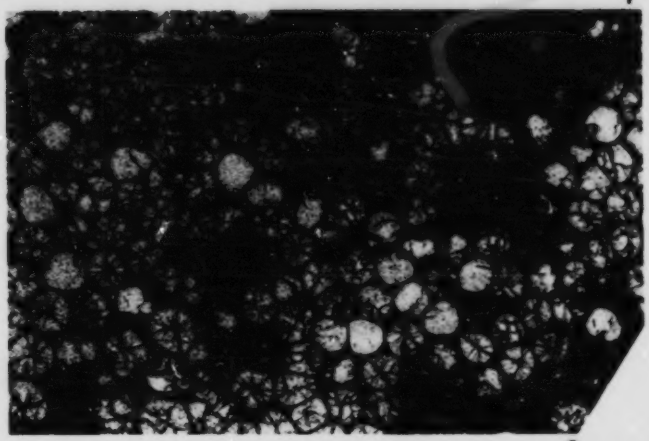

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PLATE 17

Frobisher Bay Formation

Figures 1, 3. *Amplexopora* sp. aff. *A. winchelli* Ulrich. GSC 113483, longitudinal and transverse thin sections, x10, x20, GSC loc. O-104199 (Jordan River).

Figures 2, 4. *Rhombotrypa*(?) sp. GSC 113484, longitudinal and tangential thin sections, x20, GSC loc. O-104483 (Sylvia Grinnell Lake).

Figures 5, 6. *Eridotrypa* sp. aff. *E. sadievillensis* Karklins. GSC 113482, longitudinal and tangential thin sections, x20, GSC loc. O-104530 (Jordan River).

Figure 7. *Ulrichostylus* sp. GSC 113487, longitudinal thin section, x20, GSC loc. O-104530 (Jordan River).

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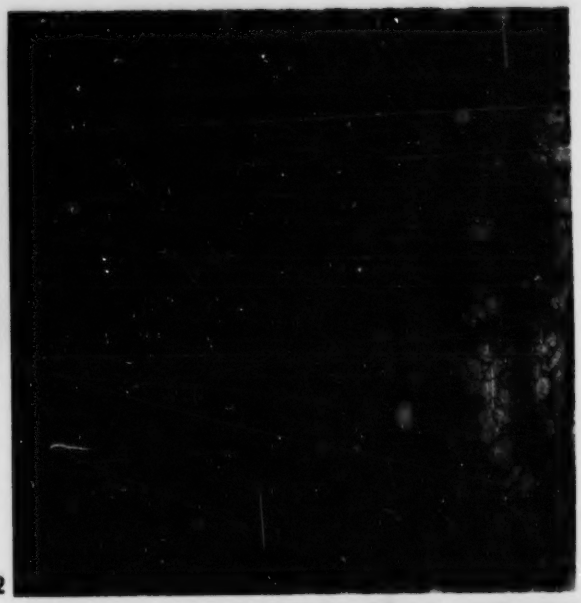

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PLATE 18

Amadjuak Formation

Figures 1, 2. *Tarphophragma* sp. GSC 113485, tangential and longitudinal thin sections, x20, x10, GSC loc. O-104516 (Silliman's Fossil Mount).

Figures 4, 6. *Paucicrura rogata* (Sardeson). GSC 113503, 113504, brachial valve exterior, x2 and pedicle valve exterior associated with cystid plate, x4, both GSC loc. O-104189 (Hone River).

Figures 8–10, 13–17. *Hesperorthis interplicata* Roy

8. GSC 113488, brachial valve exterior, x3, GSC loc. O-104229 (Silliman's Fossil Mount).

9, 10. GSC 113489, pedicle and brachial valves exterior, x2, GSC loc. O-104480 (Amadjuak(?) Formation, ?talus, Sylvia Grinnell Lake).

13. GSC 113490, posterior view of conjoined valves, x3, GSC loc. O-104229 (Silliman's Fossil Mount).

14, 16. GSC 113491, pedicle and brachial valves exterior, x2, GSC loc. O-104516 (Silliman's Fossil Mount).

15. GSC 113492, brachial valve exterior, x4, GSC loc. O-104517 (Silliman's Fossil Mount).

17. GSC 113493, lateral view of conjoined valves, x1, GSC loc. O-104518 (Silliman's Fossil Mount).

Figure 12. *Rhabdoporella* sp. GSC 113494, x40, GSC loc. O-104525 (Silliman's Fossil Mount).

Figures 18–20, 22, 23. *Plaesiomys subcircularis* (Roy)

18, 23. GSC 113495, 113496, brachial and pedicle valves exterior, x2, both GSC loc. O-104229 (Silliman's Fossil Mount).

19, 20, 22. GSC 113497–113499, pedicle, brachial and pedicle valves exteriors, x2, x1, x2, GSC loc. O-104517, O-104526 and O-104516 (all Silliman's Fossil Mount).

Frobisher Bay Formation

Figures 3, 7. *Strophomena* sp. GSC 113501, 113502, x1, x2, both GSC loc. O-104190 (Hone River).

Figure 5. *Rafinesquina* sp. GSC 113505, x1, GSC loc. O-104190 (Hone River).

Figures 11, 21. *Ceramopora* sp. GSC 113486, tangential and longitudinal thin sections, x40, x20, GSC loc. O-104530 (Jordan River).

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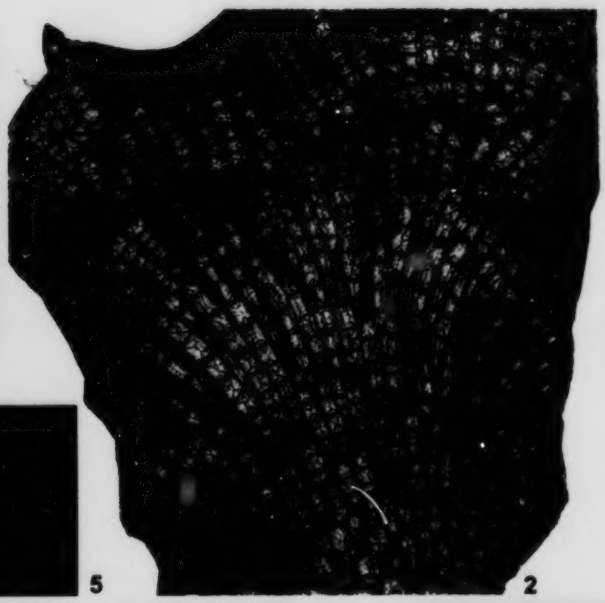
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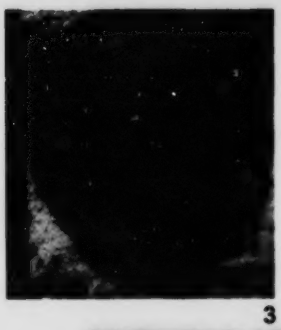
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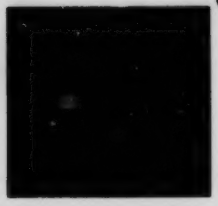
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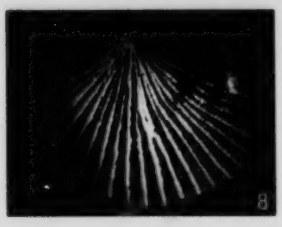
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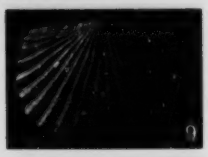
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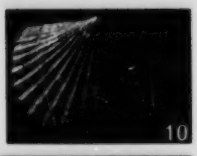
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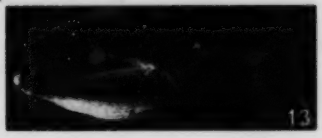
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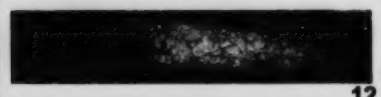
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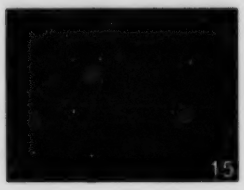
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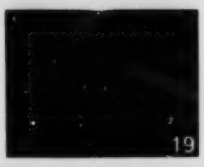
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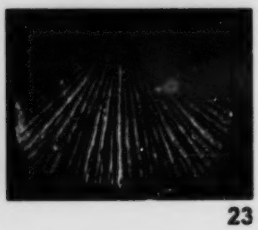
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PLATE 19

Amadjuak Formation
(Silliman's Fossil Mount except Figure 17)

Figures 1, 2. *Austinella cooperi* Roy. GSC 42981, brachial and pedicle valve exteriors, x2, x1, GSC loc. 15862 (collected by A.K. Miller and W. Youngquist in 1947 from the northwest mound).

Figure 3. *Plaesiomys subcircularis* (Roy). GSC 113500, brachial valve exterior, x2, GSC loc. O-104516.

Figures 4, 5. *Plectorthis inaequiconvexa* Roy. GSC 113506, 113507, brachial valve views of conjoined valves, x1, x2, GSC loc. O-104198 and O-104516.

Figure 6. *Resserella diminutiva* (Roy). GSC 113508, pedicle valve exterior, x4, GSC loc. O-104198.

Figures 7, 8, 11, 12. *Platystrophia magnisulcata* Roy

7, 11, 12. GSC 113509, pedicle valve exterior, posterior view of conjoined valves and brachial valve exterior, x4, GSC loc. O-104516.

8. GSC 113510, brachial valve exterior, x2, GSC loc. O-104507.

Figures 9, 10, 14–16, 18, 19, 23. *Resserella sillimani* (Roy)

9. GSC 113511, posterior view of conjoined valves, x3, GSC loc. O-104229.

10, 14, 15. GSC 113512, pedicle valve exterior, x4, anterior and dorsal views of conjoined valves, x4, x6 (collected by A.K. Miller and W. Youngquist).

16. GSC 113513, brachial valve view of conjoined valves, x3, GSC loc. O-104229.

18. GSC 113514, brachial valve exterior of conjoined valves, x3, GSC loc. O-104229.

19, 23. GSC 113515, 113516, pedicle valve exteriors, x2, GSC loc. O-104516 and O-104229.

Figure 13. *Sowerbyella* sp. GSC 113517, brachial valve exterior, x2, GSC loc. O-104526.

Figures 20, 21. *Strophomena* sp. 1 Roy. GSC 113518, 113519, x2, GSC loc. O-104526 and O-104229.

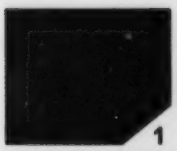
Figure 22. *Sowerbyella* sp. cf. *S. thraivensis* (Reed). GSC 113520, brachial valve exterior, x4, associated with *Calyptaulax ludvigseni* n. sp., incomplete cephalon, GSC loc. O-104518.

Figure 24. *Sowerbyella* sp. GSC 113521, brachial valve exterior, x2, associated with *Calyptaulax ludvigseni* n. sp., *Remipyga*(?) sp., ostracodes, echinoderm plates, and various shaped columnals, GSC loc. O-104518.

Figure 25. *Rafinesquina*(?) *declivis subnutans* Roy. GSC 113522, x2, GSC loc. O-104507.

Bad Cache Rapids Group

Figure 17. *Resserella sillimani* (Roy). GSC 113783, posterior view of conjoined valves, x4, GSC loc. 84640 (White Island, Nunavut).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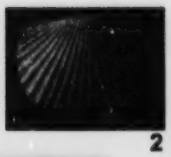
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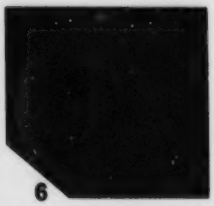
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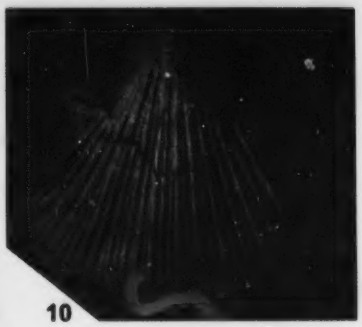
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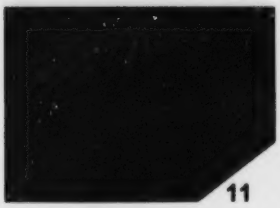
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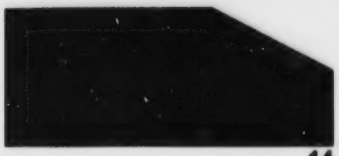
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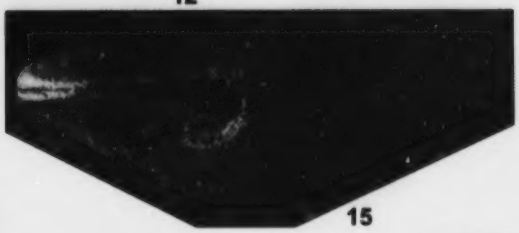
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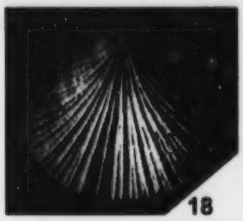
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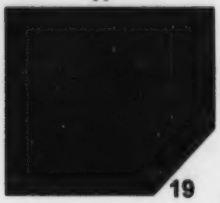
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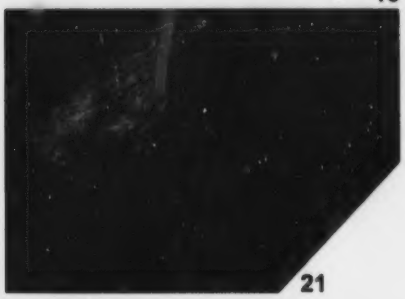
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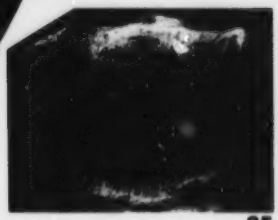
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PLATE 20

Amadjuak Formation
(Silliman's Fossil Mount except Figures 1, 2, 38)

Figures 1, 7, 12, 23. *Rafinesquina*(?) *pronis* Roy

1. GSC 113523, brachial valve interior, x2, GSC loc. O-104492 (Amadjuak(?) Formation, ?talus, Sylvia Grinnell Lake).

7. GSC 113524, pedicle valve exterior, x2, GSC loc. O-104516.

12, 23. GSC 113525, pedicle valve exterior and concave brachial valve exterior of conjoined valves, x2, GSC loc. O-104512.

Figure 2. *Kjaerina* sp. GSC 113526, x2, GSC loc. O-104192 (Nuvungmiut River).

Figures 3–6, 8, 18. *Parastrophina minor* (Roy)

3, 4. GSC 113527, anterior view of conjoined valves and pedicle valve exterior, x2, GSC loc. O-104516.

5. GSC 113528, oblique anterior view of conjoined valves, x2, GSC loc. O-104516.

6. GSC 113529, brachial valve exterior, x3, GSC loc. O-104229.

8, 18. GSC 113530, pedicle valve exterior and lateral view of conjoined valves, x2, GSC loc. O-104516.

Figures 9–11, 13–15, 20. *Lepidocyclus*(?) *arctica* (Roy)

9. GSC 113531, pedicle valve exterior, x2, GSC loc. O-104516.

10, 11. GSC 113532, 113533, pedicle and brachial valve exteriors, x3, both GSC loc. O-104229.

13, 20. GSC 113534, 113535, anterior views of conjoined valves showing both deep, narrow and wide sinus, x2, both GSC loc. O-104516.

14. GSC 113536, lateral view of conjoined valves, x3, GSC loc. O-104229.

15. GSC 113537, brachial valve exterior, x2, GSC loc. O-104516.

Figures 16, 17. *Idiospira maynei* (Roy). GSC 113538, 113539, brachial valve exteriors, x4, GSC loc. O-104516 and O-104517.

Figures 19, 24. *Lepidocyclus*(?) *breve* (Roy). GSC 113540, 113541, brachial and pedicle valve exteriors, x2, both GSC loc. O-104516.

Figures 21, 22, 25–28. *Cyclospira schucherti* Roy

21, 22, 27, 28. GSC 113542, pedicle, brachial, anterior, and lateral views of conjoined valves, x4, GSC loc. O-104229.

25. GSC 113543, pedicle valve exterior, x4, GSC loc. O-104517.

26. GSC 113544, anterior view of conjoined valves, x4, GSC loc. O-104507.

Figures 29, 30, 36. *Kokenospira* sp. cf. *K. costalis* (Ulrich and Scofield)

29, 36. GSC 113547, anterior and left sides, x3, GSC loc. O-104229.

30. GSC 113548, anterior side, x3, GSC loc. O-104229.

Figures 31, 40. *Tetranota* sp. GSC 113549, 113550, apertural view and anterior side, x3, x2, GSC loc. O-104516 and O-104229.

Figures 32, 33. *Cyclospira schucherti* Roy. GSC 113545, brachial and lateral view of conjoined valves, x4, GSC loc. O-104232.

Figure 34. *Strophomena fluctuosa* Billings. GSC 113546, x1, GSC loc. O-104526.

Figures 35, 37. *Liospira* sp. GSC 113551, 113552, x4, x1, GSC loc. O-104229 and O-104516.

Figure 38. *Salpingostoma* sp. GSC 113553, x1, GSC loc. O-104204 (Amadjuak Lake).

Figure 39. *Holopea arctica* Schuchert. GSC 113554, x4, GSC loc. O-104229.

Figure 41. *Phragmolites* sp. GSC 113555, right side, x6, GSC loc. O-104516.

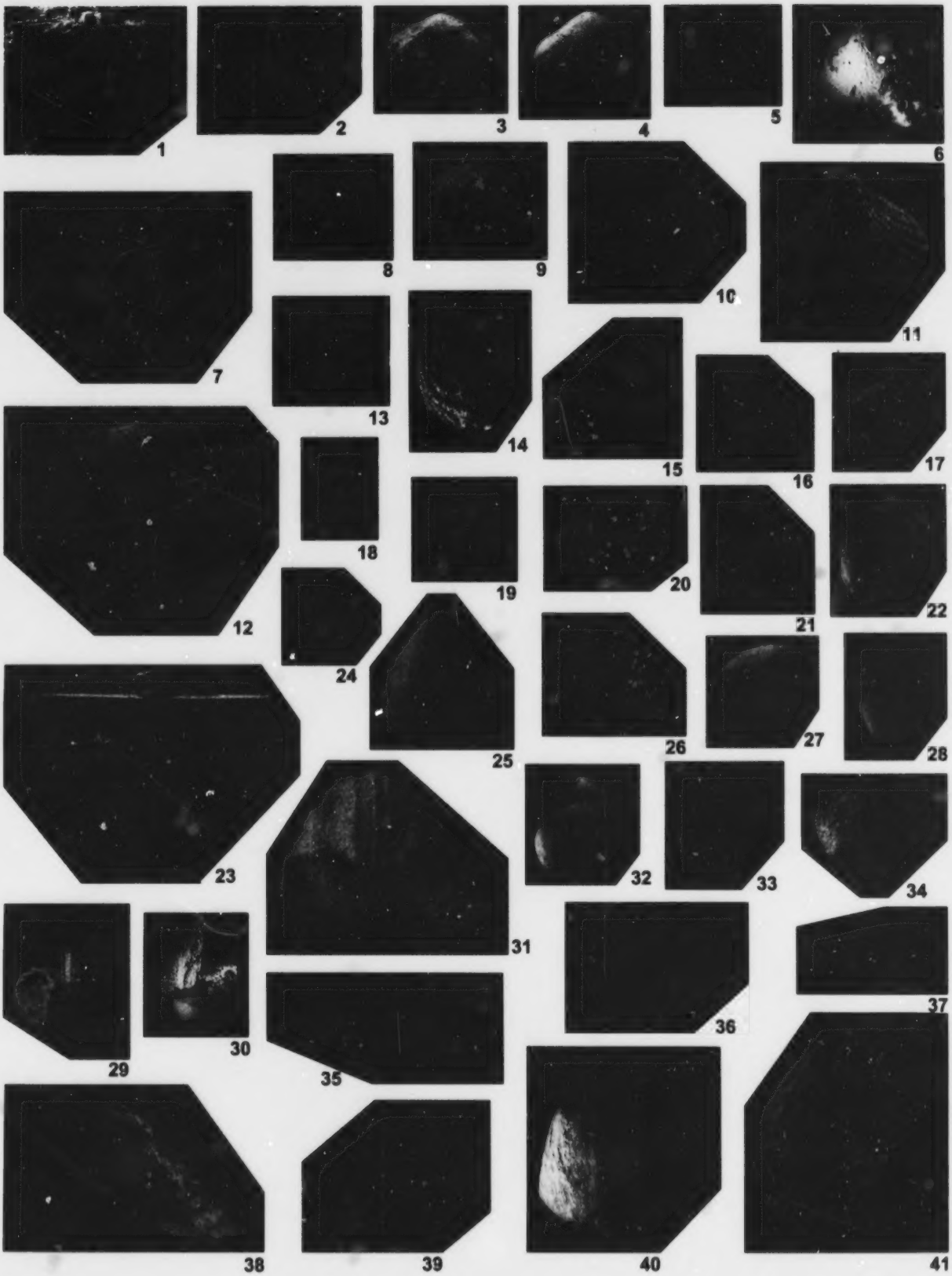
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PLATE 21

Amadjuak Formation
(Silliman's Fossil Mount except Figures 3, 32)

Figures 1–4. *Liospira* sp. GSC 113556–113559, x3, x2, x1, x3, GSC loc. O-104229 (Silliman's Fossil Mount), O-104516, O-104207 (Amadjuak Lake) and O-104229 (Silliman's Fossil Mount).

Figures 5–9. *Eotomaria robinsoni* Roy

5. GSC 113560, 4x, GSC loc. O-104516.

6–9. GSC 113561–113564, x1, x2, x3, x2, all from GSC loc. O-104229.

Figures 10–12, 14–17. *Loxoplocus* (*Lophospira*) sp.

10, 12, 14, 16. Figured specimens GSC 113565, x3, 113567, x2, 113568, x3 and 113570, x2, all GSC loc. O-104229.

11, 15. Figured specimens GSC 113566, 113569, x2, GSC loc. O-104516.

17. Figured specimen GSC 113571 x1, GSC loc. O-104517.

Figures 13, 19, 24. *Pseudocryptaenia* sp. GSC 113572, x3, GSC loc. O-104229, GSC 113573, x4, x4, GSC loc. O-104516.

Figures 18, 20, 21. *Trochonema* (*Trochonema*) sp. GSC 113574–113576, x1, x2, x2, GSC loc. O-104229, O-104516, and O-104229.

Figure 22. *Holopea* sp. GSC 113577, x1, GSC loc. O-104507.

Figure 23. *Naticonema*(?) sp. GSC 113578, x2, GSC loc. O-104516.

Figure 25. *Threavia* sp. GSC 113579, x1, GSC loc. O-104507.

Figure 26. *Maclurites altus* Wilson. GSC 113580, x1, GSC loc. O-104525.

Figures 27, 28. *Seelya ulrichi* Schuchert. GSC 113581, 113582, x3, both GSC loc. O-104229.

Figure 29. *Ecculiomphalus* sp. GSC 113583, x4, GSC loc. O-104516.

Figure 30. *Maclurites acutus* Parks. GSC 113584, x1, GSC loc. O-104198.

Figure 31. *Subulites* (*Fusispira*) sp. GSC 113585, x2, GSC loc. O-104229.

Figure 32. *Hormotoma rotundivolvis* Roy. GSC 113586, x1, GSC loc. O-104207 (Amadjuak Lake).

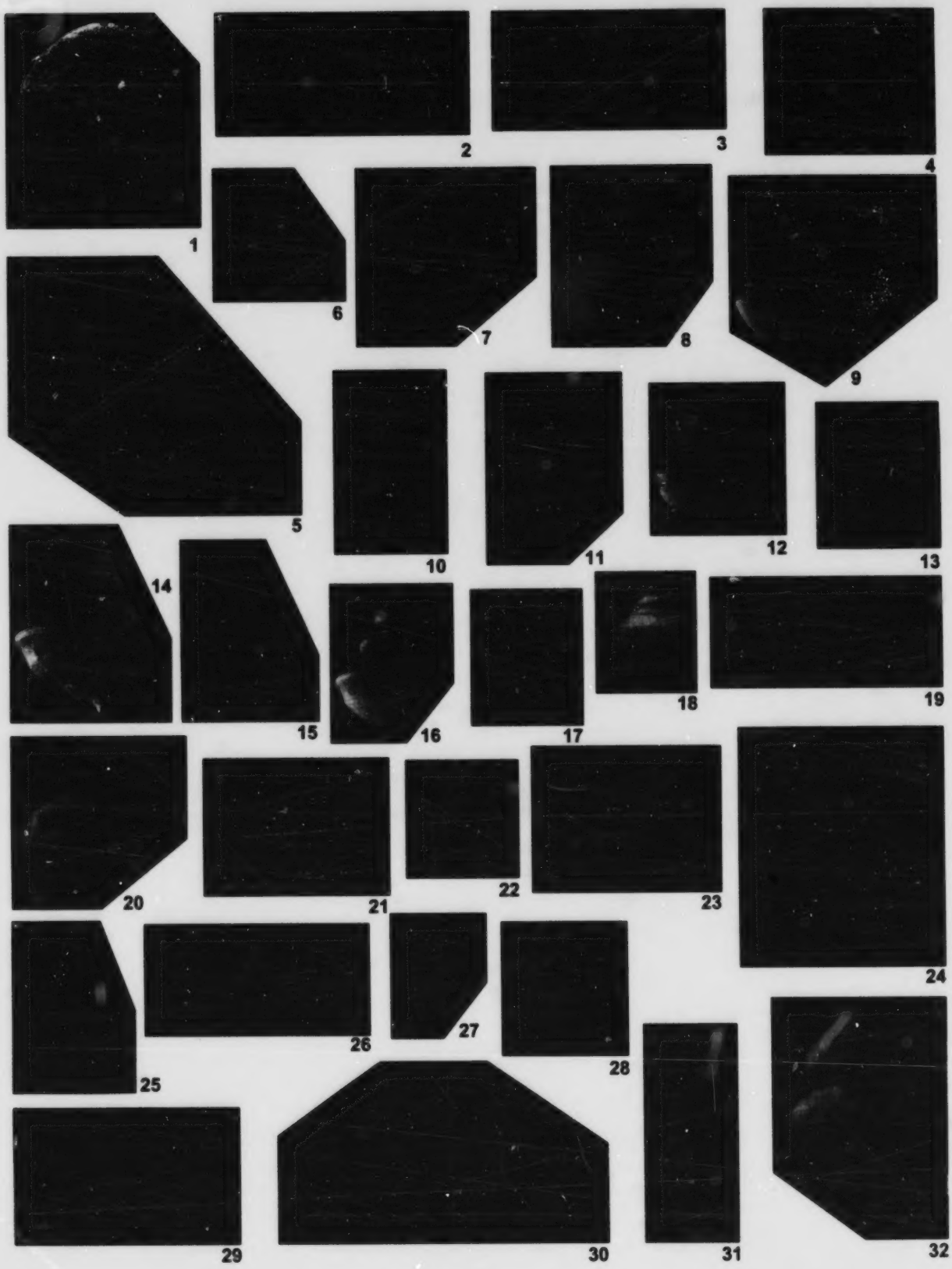
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PLATE 22

Amadjuak Formation
(Silliman's Fossil Mount)

Figures 1–4. *Gyronema*(?) sp. GSC 113587–113590, x2, x2, x2, x4 (showing strong growth lines and lirae), GSC loc. O-104516.

Figures 5, 7–9. *Seelya ulrichi* Schuchert

5. GSC 113591, x3, GSC loc. O-104229.

7–9. GSC 113592–113594, x2, x2, x4, GSC loc. O-104516.

Figures 6, 10, 11, 19. *Ctenodonta* sp. cf. *C. subnasuta* Ulrich

6. GSC 113600, right valve, x2, GSC loc. O-104516.

10, 11, 19. GSC 113601–113603, right valves, x2, GSC loc. O-104229.

Figures 12, 15, 18. *Maclurites triangularis* Teichert. GSC 113595–113597, x2, x1, x1, GSC loc. O-104507, O-104518, and O-104526.

Figure 14. *Maclurites ovalis* Wilson. GSC 113598, x1, GSC loc. O-104526.

Figure 17. *Maclurina* sp. GSC 113599, fragment preserving both fine and coarse growth lines, x1, GSC loc. O-104523.

Upper Ordovician

Figures 13, 16. *Maclurites arctica* (Haughton). Plaster cast of holotype, National Museum of Ireland 95:1905/290, GSC 113784, basal and apertural views, x1, from granite beach, Depot Bay, Beloit Straits.

Bad Cache Rapids Group

Figures 20, 21. *Maclurites triangularis* Teichert. GSC 113785, basal and apertural views, x1, GSC loc. 84610 (creek flowing into Duke of York Bay, Southampton Island).

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PLATE 23

Amadjuak Formation
(Silliman's Fossil Mount except for Figure 19)

Figures 1–3, 7, 10. *Myoplusia carpenderi* (Schuchert)

1,3. GSC 113604, 113606 both x2, left valves, GSC loc. O-104229.

2. GSC 113605, x6, conjoined valves, GSC loc. 104516.

7, 10. GSC 113607, 113608, both x4, conjoined valves, GSC loc. O-104229.

Figures 4, 6, 8, 11, 12. *Deceptrix baffinense* (Ulrich)

4, 8. GSC 113609, right valve and dorsal view, x3, GSC loc. O-104229.

6. GSC 113610, anterior view of conjoined valves, x3, GSC loc. O-104229.

11, 12. GSC 113611, 113612, right and left valves, x3, GSC loc. O-104516.

Figures 5, 9. *Ctenodonta frobisherensis* Schuchert. GSC 113613, 113614, x2, right and left valves, GSC loc. O-104229.

Figures 13, 14. *Cyrtodonta sillimanensis* Schuchert. GSC 113615, 113616, right valves, x2, GSC loc. O-104229 and O-104516.

Figure 15. *Modiolopsis*(?) sp. GSC 113617, right valve, x2, GSC loc. O-104516.

Figure 18. *Whiteavesia symmetrica* Schuchert. GSC 113618, right valve, x3, GSC loc. O-104229.

Figure 19. *Maclurina manitobensis* (Whiteaves). GSC 113619, basal view, x 3/4, GSC loc. O-104193 (unnamed lake, northwest of Sylvia Grinnell Lake).

Figure 20. *Cyrtodontula arctica* (Schuchert). GSC 113620, right valve, x2, GSC loc. O-104516.

Figure 21. *Vanuxemia baffinensis* Schuchert. GSC 113621, right valve, GSC loc. O-104518.

Figures 22–24. *Technophorus* sp. cf. *T. cancellatus* Ruedemann. GSC 113622–113624, right and left valves, x2, x3, x4, GSC loc. O-104516.

Akpatok Formation

Figures 16, 17. *Narthecoceras sinclairi* Flower. GSC 113786, 113787, longitudinal and transverse thin sections (note compressed tube, growth lines and borings), x1, GSC loc. O-104663 (Gregson Creek, Akpatok Island, collected by J. Gray in 1989).

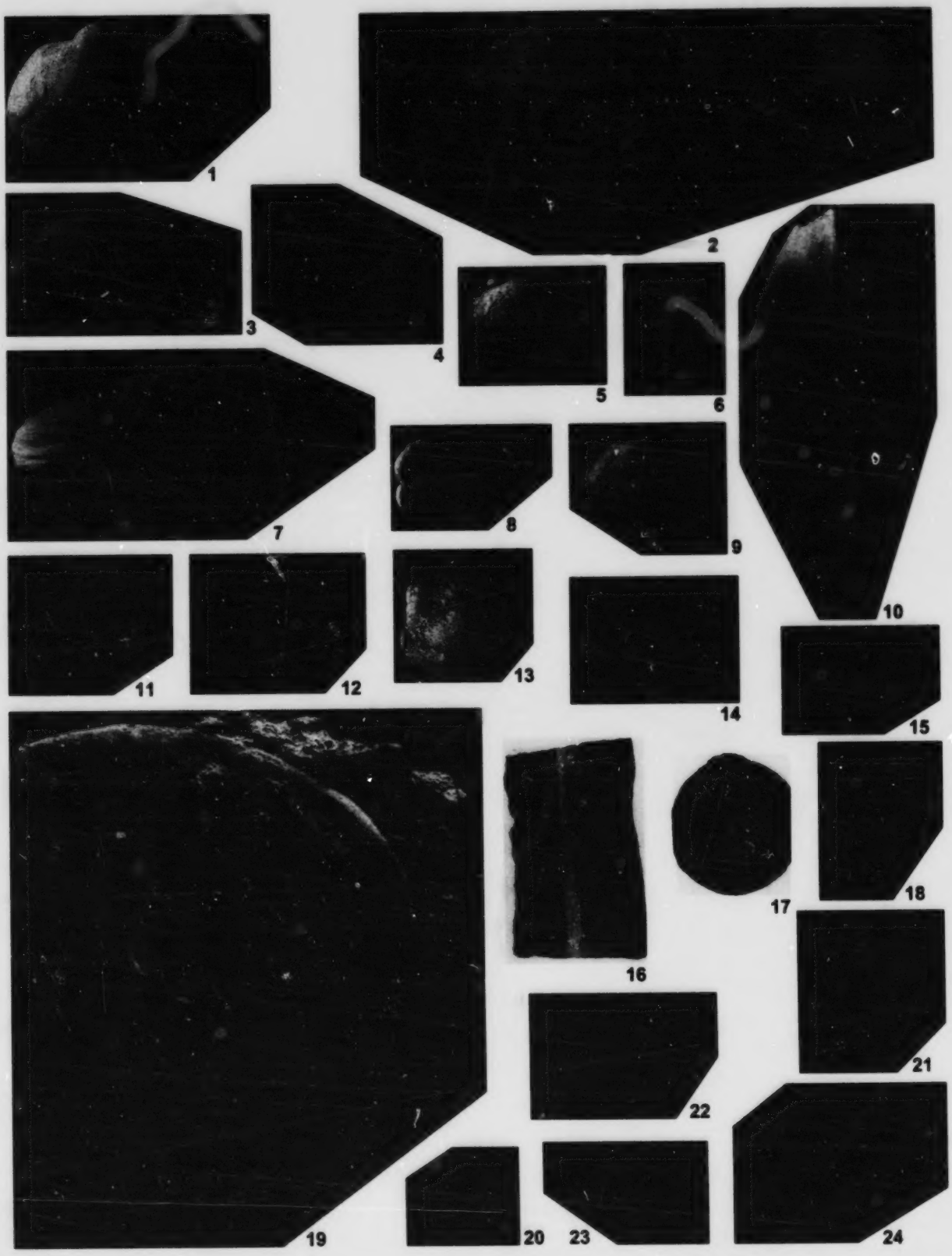
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PLATE 24

Amadjuak Formation

Figures 1, 12. *Beloitoceras gouldi* (Foerste). GSC 113625, 113626, lateral (x2), venter left, and dorsal (x1) views, GSC loc. O-104512 (Silliman's Fossil Mount) and O-104194 (Putnam Highland).

Figure 2. *Seelya ulrichi* Schuchert. GSC 113627, x4, GSC loc. O-104516 (Silliman's Fossil Mount).

Figure 3. *Eoleperditia* sp. GSC 113628, x2, GSC loc. O-104480 (Amadjuak(?) Formation, ?talus, Sylvia Grinnell Lake).

Figure 6. *Nanillaenus punctatus* (Roy). GSC 113629, dorsal view of cranidium, x2, GSC loc. O-104480 (Amadjuak(?) Formation, ?talus, Sylvia Grinnell Lake).

Figures 7, 9. *Westonoceras*(?) sp. GSC 113630, 113631, lateral (x2), venter left, and ventral (x1) views, GSC loc. O-104516 and O-104512 (both Silliman's Fossil Mount).

Figure 8. *Beloitoceras cornulum* (Schuchert). GSC 113632, lateral view, venter left, x1, GSC loc. O-104516 (Silliman's Fossil Mount).

Figure 10. *Maclurina* sp. GSC 113633, photographed under water to show fine growth lines and extensive boring, x1, GSC loc. O-104189 (Hone River).

Figures 11, 13. *Billingsites*(?) sp. GSC 113634, dorsal and lateral, venter right, views, x1, GSC loc. O-104201 (Jordan River).

Bad Cache Rapids Group

Figures 4, 5. *Maclurites acutus* var. *major* Troedsson. GSC 113795, basal and side views, x1, GSC loc. 84657 (northwest of Coral Harbour, Southampton Island).

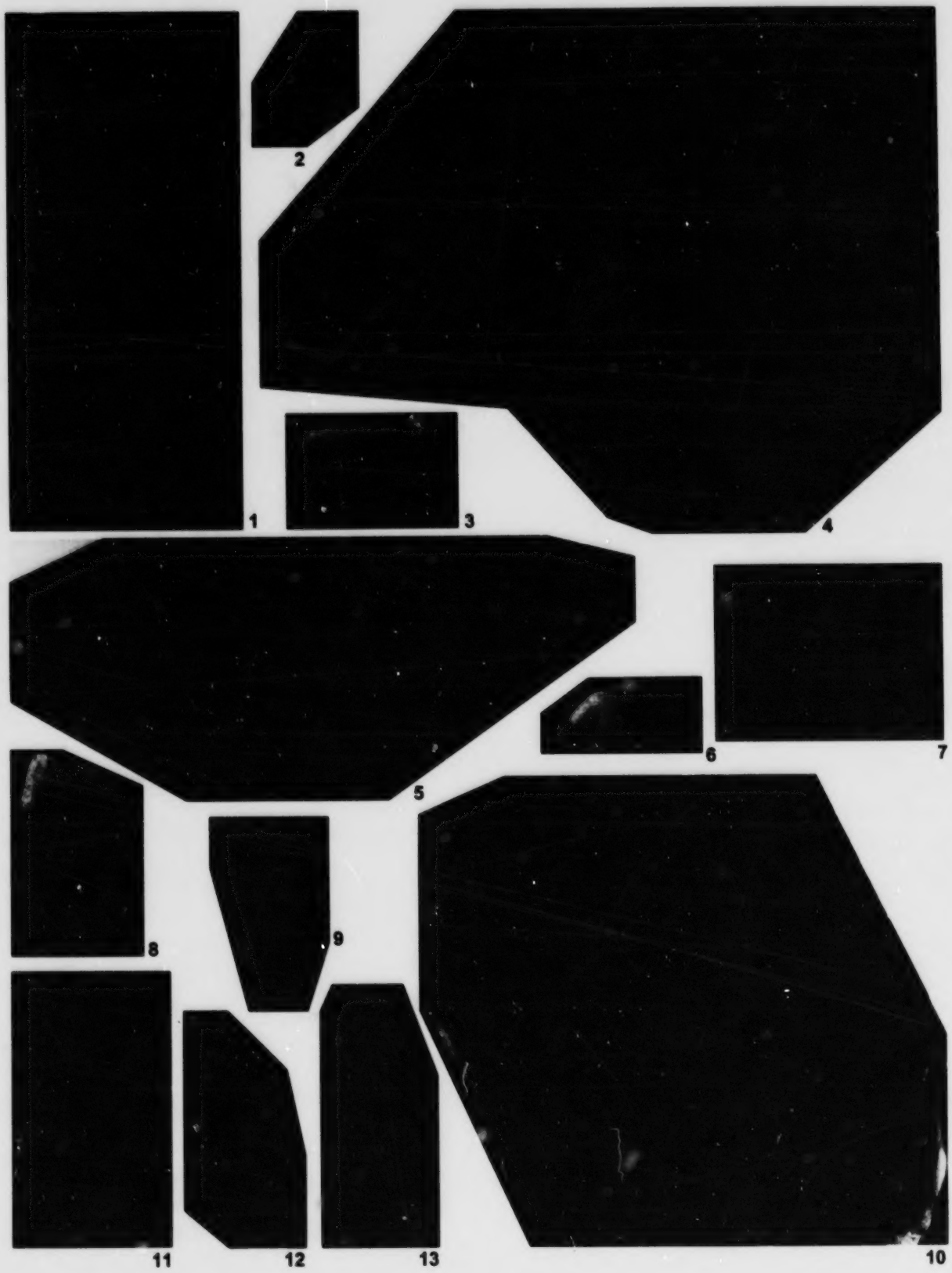
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PLATE 25

Bad Cache Rapids Group

Figures 1, 8. *Maclurina manitobensis* (Whiteaves). GSC 113796, 113797, basal views, x1/2 and x1, GSC loc. 84617 (creek 0.8 km west of Coral Harbour) and 84657 (northwest of Coral Harbour), Southampton Island.

Amadjuak Formation

Figure 2. *Actinoceras ruedemanni* var. *clarkei* (Troedsson). GSC 113635, lateral view, x2, GSC loc. O-104507 (Silliman's Fossil Mount).

Figures 3, 4. *Hypodicranotus* sp. GSC 113636, 113637, incomplete cranidia, x3, GSC loc. O-104517 and O-104516 (both Silliman's Fossil Mount).

Figure 5. *Ceraurus* sp. GSC 113638, pygidium, ventral view, x2, GSC loc. O-104518 (Silliman's Fossil Mount).

Figure 9. *Flexicalymene*(?) sp. GSC 113639, dorsal view of a pygidium, x4, GSC loc. O-104189 (Hone River).

Frobisher Bay Formation

Figure 7. *Endoceras chidleyense* Foerste. GSC 113640, natural weathered longitudinal section exposing siphuncle, x1, GSC loc. O-104208 (Sylvia Grinnell Lake).

Figure 10. *Endoceras* n. sp. A. GSC 113641, ventral view of phragmocone, xl, GSC loc. O-104491 (Sylvia Grinnell Lake).

Cobourg beds (Edenian)

Figure 6. *Hypodicranotus striatulus* (Walcott). GSC 113798, hypostome, x2, GSC loc. O-106389 (roadcut on Bearhill Road 0.8 km north of Highway 44 east of Almonte, Ontario).

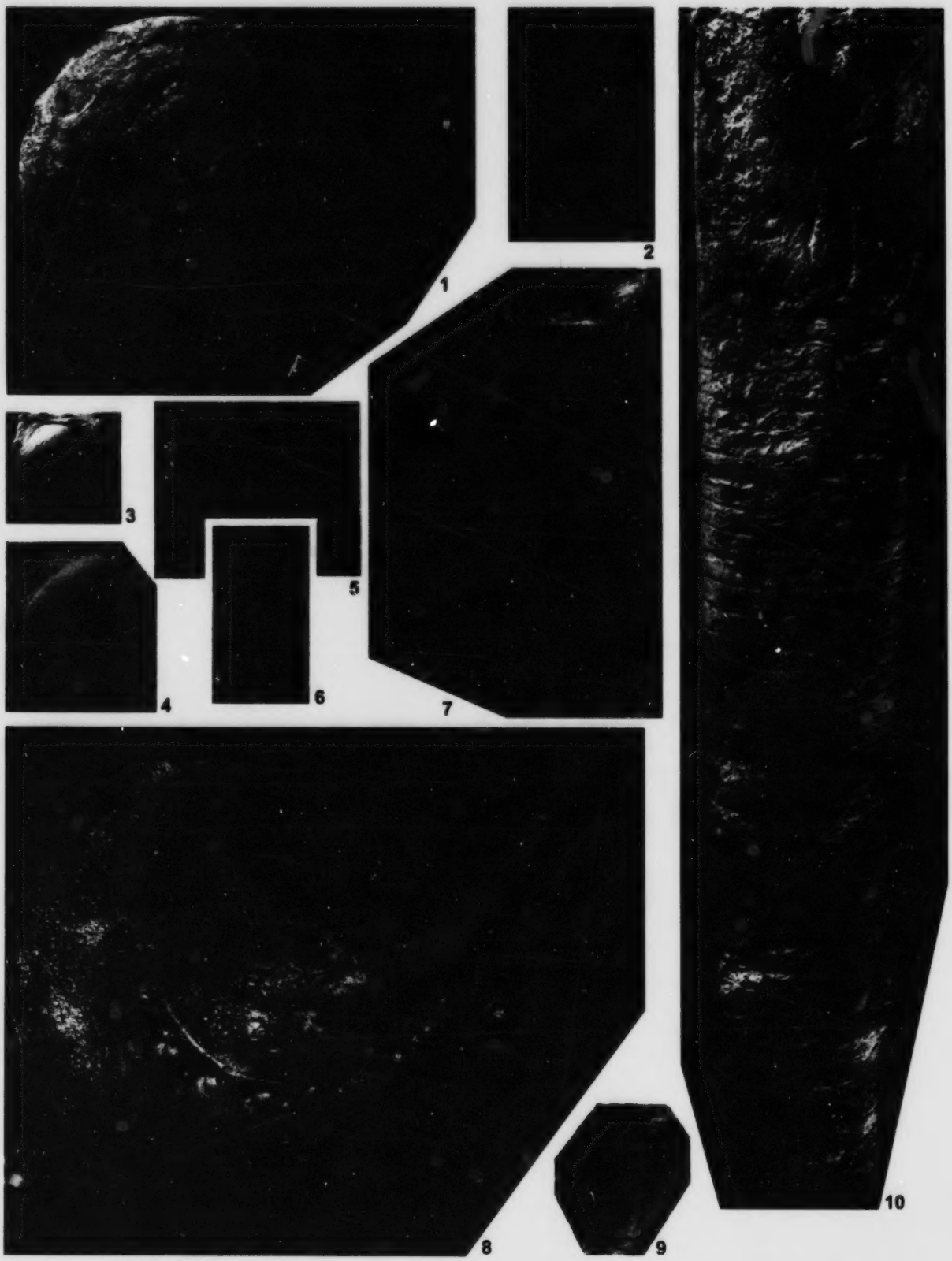
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PLATE 26

Frobisher Bay Formation

Figure 1. *Endoceras* n. sp. A. GSC 113642, phragmocone weathered to show siphuncle, x1, GSC loc. O-104197 (Hone River).

Figure 2. *Ormoceras*(?) sp. GSC 113644, natural weathered phragmocone showing siphuncle, x1, GSC loc. O-104208 (Sylvia Grinnell Lake).

Figure 3. *Gonioceras wulffi* Troedsson. GSC 113645, natural weathered section of a phragmocone, x1, GSC loc. O-104197 (Hone River).

Figure 4. *Endoceras*(?) sp. GSC 113646, infilling of siphuncle, ventral view, x1, GSC loc. O-104208 (Sylvia Grinnell Lake).

Figure 9. *Discoceras* sp. aff. *D. canadensis* (Whiteaves). GSC 113647, x1, GSC loc. O-104208 (Sylvia Grinnell Lake).

Amadjuak Formation
(Silliman's Fossil Mount)

Figures 5, 8. *Dimeropyge raymondi* (Roy). GSC 113648, incomplete cephalon, dorsal and lateral views, x6, GSC loc. O-104517.

Figure 6. *Denella goodridgii* (Schuchert). GSC 113649, pygidium dorsal view, x2, GSC loc. O-104517.

Figure 7. *Anataphrus borraeus* Whittington. GSC 113650, anterior view of a small enrolled specimen, x3, GSC loc. O-104517.

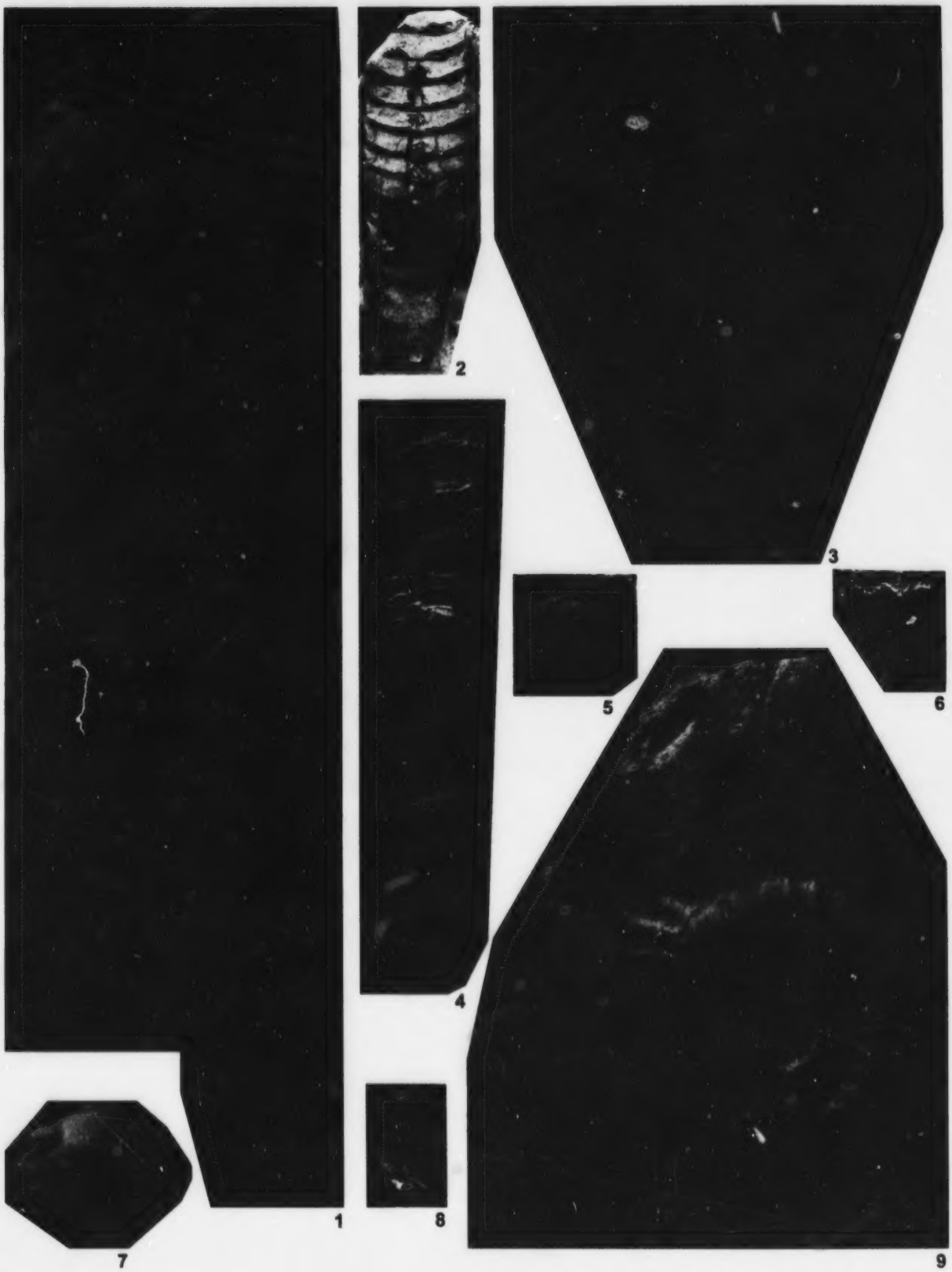
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PLATE 27

Frobisher Bay Formation

Figures 1, 7, 10. *Gonioceras wulffi* Troedsson. GSC 113651, natural weathered phragmocone, x1/2, GSC 113652, showing trace of siphuncle, x1, and GSC 113645, showing siphuncle on ventral side of a lower extension of same specimen on Pl. 26, fig. 3, x1, GSC loc. O-104190 (Hone River), O-104530 (Jordan River) and O-104197 (Hone River).

Figures 2, 3. *Kochoceras foordi* Foerste. GSC 113653, phragmocone dorsal and ventral views, x1, GSC loc. O-104497 (Sylvia Grinnell Lake).

Figures 6, 9. *Gonioceras holtedahli* Troedsson. GSC 113654, natural weathered phragmocone ventral and lateral, venter left, views, x1, GSC loc. O-104190 (Hone River).

Amadjuak Formation

Figures 4, 5. *Illaenus lacertus* Whittington. GSC 113655, 113656, pygidia, x2, x4, GSC loc. O-104518 (Silliman's Fossil Mount) and O-104480 (Amadjuak(?) Formation, ?talus, Sylvia Grinnell Lake).

Figure 8. *Oneonites* sp. GSC 113657, SEM photomicrograph, x20, GSC loc. O-104521 (Silliman's Fossil Mount).

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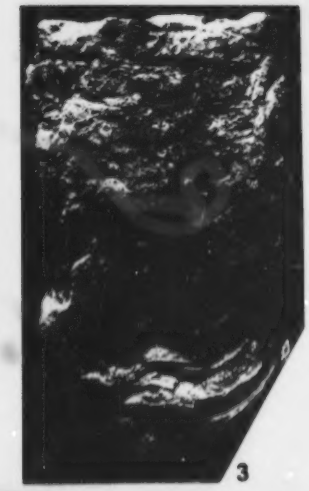
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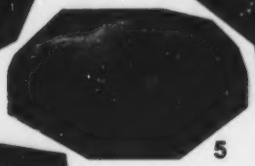
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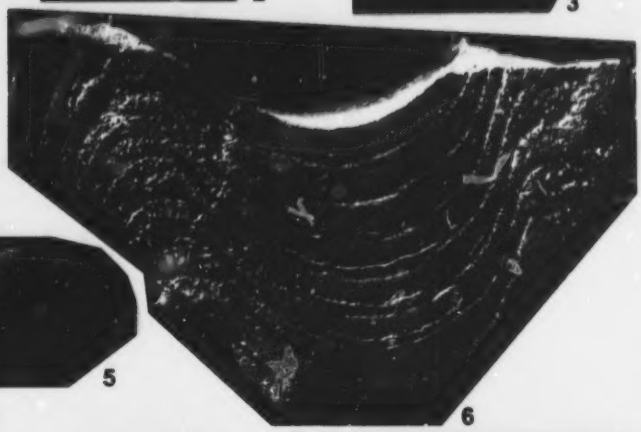
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PLATE 28

Cornwallis Formation

Figure 1. *Gonioceras groenlandicum* Troedsson. GSC 113799, phragmocone natural weathered section showing siphuncle, x1, GSC loc. 47670 (eastern Darling Peninsula, eastern Ellesmere Island).

Frobisher Bay Formation

Figures 2, 7. *Gonioceras groenlandicum* Troedsson. GSC 113658, 113659, phragmocones, dorsal views, x1, GSC loc. O-104499 (Sylvia Grinnell Lake).

Figures 8, 12. *Gonioceras* sp. cf. *G. angulatum* Troedsson. GSC 113661, phragmocone, ventral and transverse views, x1, GSC loc. O-104499 (Sylvia Grinnell Lake).

Amadjuak Formation

Figures 3, 4, 9. *Encrinuroides*(?) sp. GSC 113662–113664, pygidia, right lateral and dorsal views, x4, x6, x1, all GSC loc. O-104480 (Amadjuak(?) Formation, ?talus, Sylvia Grinnell Lake).

Figure 5. Lichid cranidium aff. *Hemiarges*. GSC 113665, incomplete cranidium, dorsal view, x3, GSC loc. OH104198 (Silliman's Fossil Mount).

Figure 6. *Isotelus* sp. aff. *I. iowensis* Owen. GSC 113660, partly exfoliated pygidium, portion of thorax and genal spine, x1, GSC loc. O-104540 (Jordan River).

Figures 10, 11. *Sceptaspis* sp. GSC 113666, 113667, dorsal and left lateral views of pygidia, x2, x3, GSC loc. O-104516 and O-104517 (both Silliman's Fossil Mount).

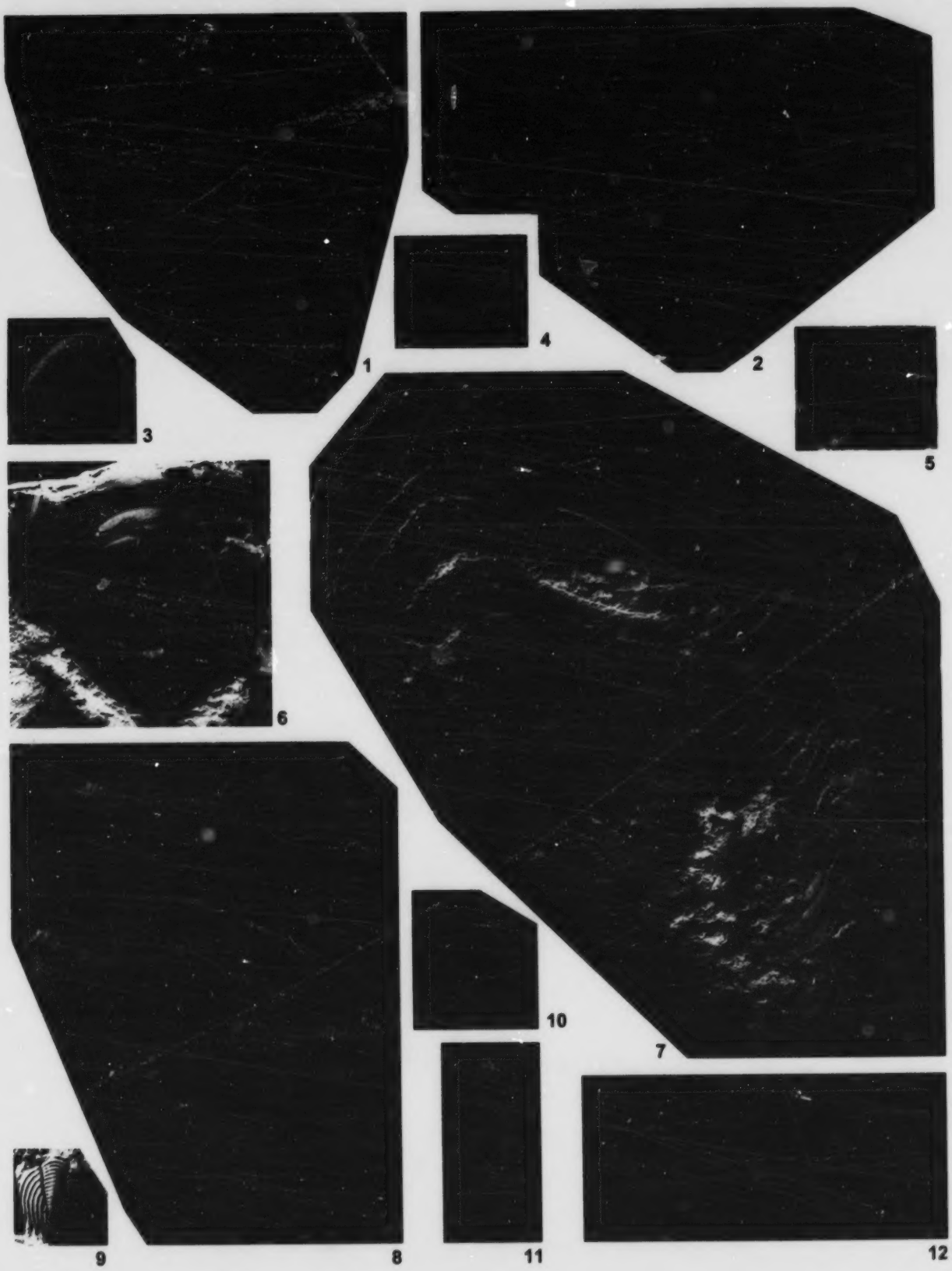
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PLATE 29

Frobisher Bay Formation

Figures 1, 6. *Richardsonoceras simplex* (Billings). GSC 113668, 113669, phragmocone and living chamber, x1, x1, GSC loc. O-104190 (Hone River) and O-104485 (Sylvia Grinnell Lake).

Figures 2, 7–9. *Gorbyoceras* sp. cf. *G. geronticum* (Foerste and Savage)

2, 7. GSC 113670, 113671, phragmocones, x1, GSC loc. O-104190 (Hone River).

8. GSC 113672, phragmocone, x1, GSC loc. O-104497 (Sylvia Grinnell Lake).

9. GSC 113673, phragmocone, x0.7, GSC loc. O-104208 (Sylvia Grinnell Lake).

Figures 10, 12. *Beloitoceras* sp. GSC 113676, ventral and dorsal views of a phragmocone, x1, GSC loc. O-104190 (Hone River).

Figure 3. *Illaenus* sp. GSC 113674, pygidium, x2, GSC loc. O-104480 (Sylvia Grinnell Lake).

Amadjuak Formation

Figure 4. *Isotelus* sp. GSC 113675, hypostome, x4, GSC loc. O-104480 (Amadjuak(?) Formation, ?talus, Sylvia Grinnell Lake).

Figure 5. *Illaenus lacertus* Whittington. GSC 113677, ventral view of a pygidium, x2, GSC loc. O-104526 (Silliman's Fossil Mount).

Figure 11. *Bumastus* (*Bumastoides*) sp. GSC 113678, pygidium and thorax of an enrolled specimen, x3, GSC loc. O-104517 (Silliman's Fossil Mount).

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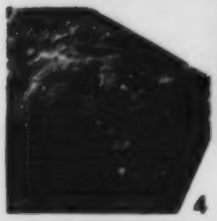
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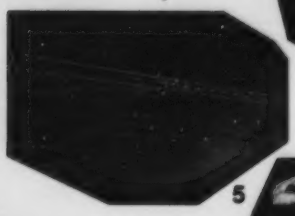
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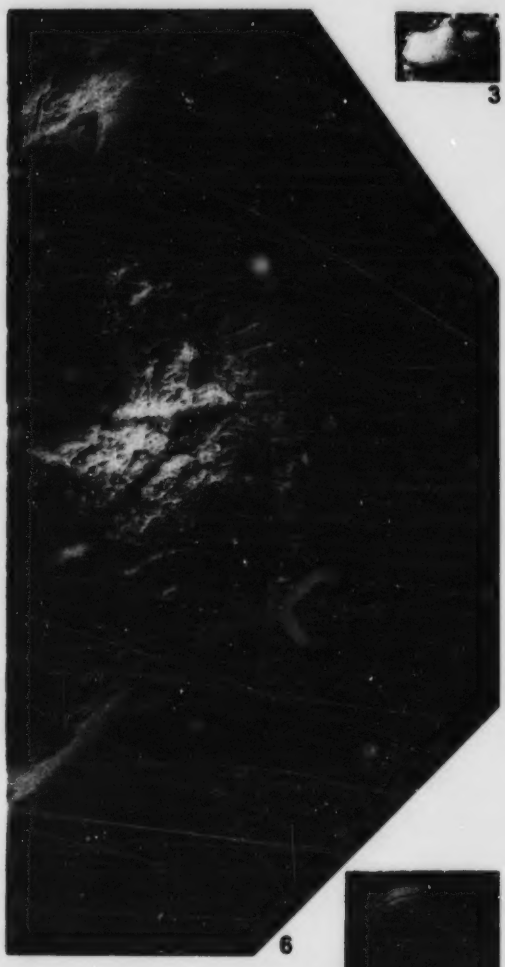
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PLATE 30

Frobisher Bay Formation

Figure 1. *Endoceras* n. sp. A. GSC 113643, phragmocone and living chamber, lateral view (venter left), x3/4, GSC loc. O-104190 (Hone River).

Figure 3. *Illaenus baffinlandicus* Roy. GSC 113679, pygidium, x2, GSC loc. O-104208 (Sylvia Grinnell Lake).

Amadjuak Formation

Figure 2. *Illaenus* sp. cf. *I. groenlandicus* Troedsson. GSC 113680, pygidium, x2, GSC loc. O-104194 (Putnam Highland).

Figure 4. *Nanillaenus punctatus* (Roy). GSC 113681, cranidium, x1, GSC loc. O-104198 (Silliman's Fossil Mount).

Figure 6. *Flexicalymene croneisi* (Roy). GSC 113682, cranidium, x2, GSC loc. O-104525 (Silliman's Fossil Mount).

Bad Cache Rapids Group

Figure 5. *Endoceras kindlei* (Foerste). GSC 113800, phragmocone, lateral view (venter right), x1, GSC loc. 84617 (creek 0.8 km west of Coral Harbour, Southampton Island).

Figure 7. *Endoceras belli* (Nelson). GSC 113801, weathered phragmocone showing siphuncle, x1, GSC loc. 85505 (Coats Island).

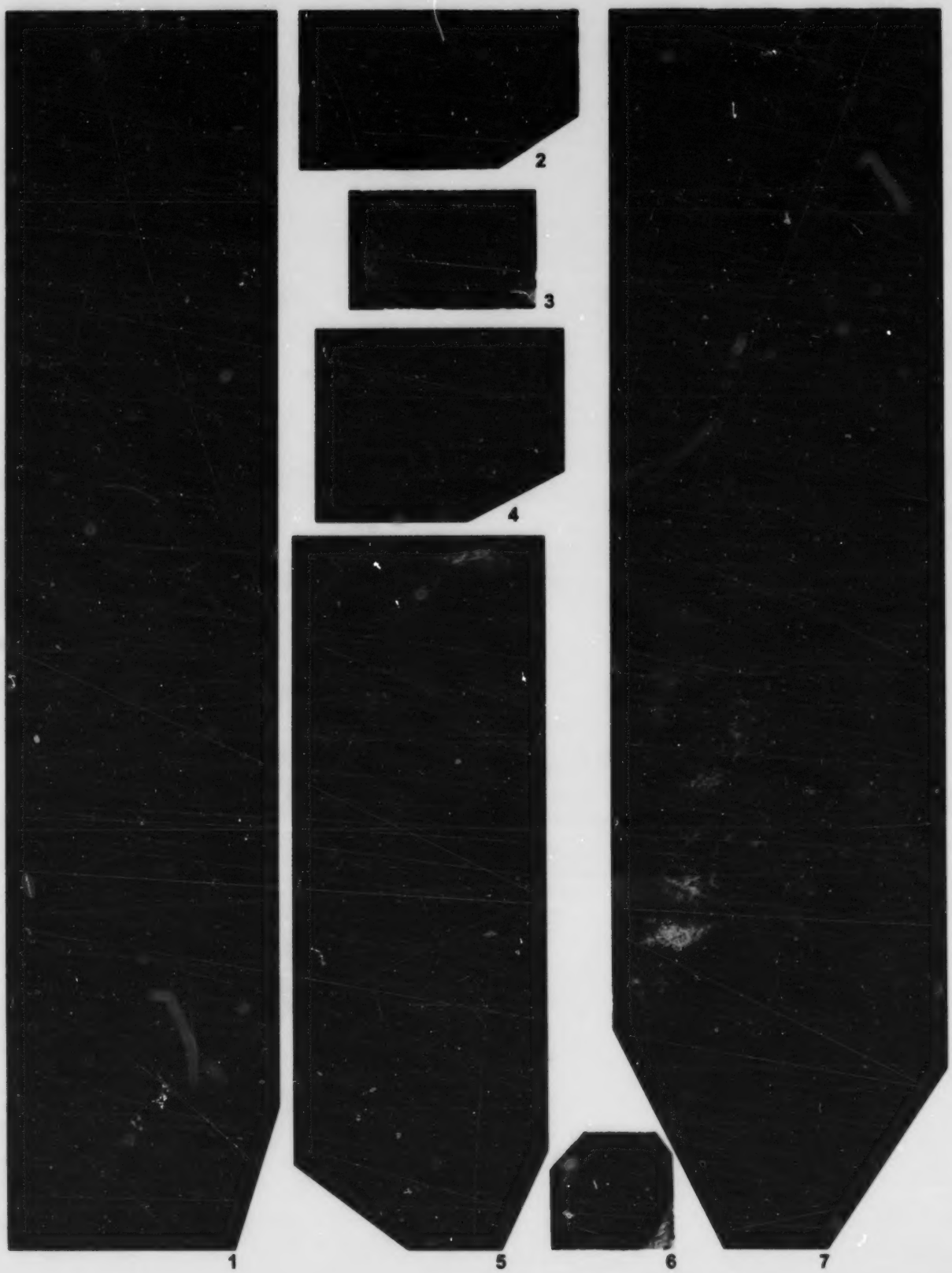
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PLATE 31

Bad Cache Rapids Group

Figures 1, 4, 5. *Kochoceras maccrackeni* n. sp.

4. GSC 113803, holotype, phragmocone, GSC loc. 84617 (creek 0.8 km west of Coral Harbour, Southampton Island).

1, 5. GSC 113802, 113804, paratypes, x1, phragmocones, longitudinal sections showing large siphuncles, both from GSC loc. 83151 (creek 0.8 km west of Coral Harbour, Southampton Island).

Figure 6. *Endoceras belli* (Nelson). GSC 113805, phragmocone and long living chamber, x1/2, GSC loc. 85505 (Coats Island).

Figures 7, 9. *Kochoceras sanfordi* n. sp. Paratype, GSC 113806, holotype, GSC 113807, x1, GSC loc. 85505 (Coats Island).

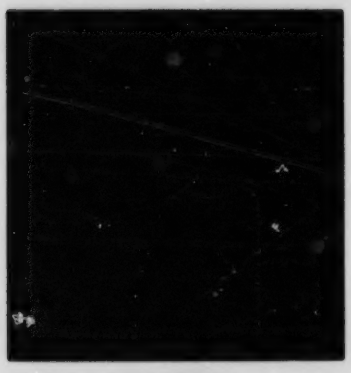
Frobisher Bay Formation

Figure 2. *Encrinuroides*(?) sp. GSC 113684, pygidium, x2, GSC loc. O-104208 (Sylvia Grinnell Lake).

Amadjuak Formation

Figure 3. *Calyptaulax ludvigseni* n. sp. GSC 113685, pygidium, x2, GSC loc. O-104507 (Silliman's Fossil Mount).

Figure 8. *Nanillaenus punctatus* (Roy). GSC 113683, pygidium, x4, GSC loc. O-104480 (Amadjuak(?) Formation, ?talus, Sylvia Grinnell Lake).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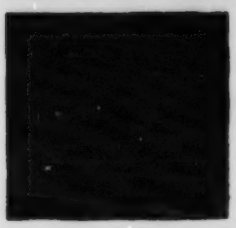
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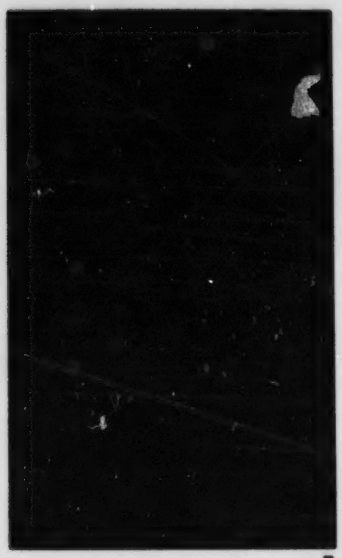
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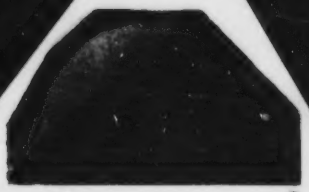
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PLATE 32

Bad Cache Rapids Group

Figures 1, 2, 5. *Narthecoceras sinclairi* Flower. GSC 113808, 113809, siphuncles, longitudinal section and dorsal views, and weathered longitudinal section, x1, GSC loc. 83151 (creek 0.8 km west of Coral Harbour) and 84807 (northwest of Coral Harbour), Southampton Island.

Figure 6. *Narthecoceras equisetum* Flower. GSC 113810, siphuncle, x1, GSC loc. 83151 (creek 0.8 km west of Coral Harbour, Southampton Island).

Amadjuak Formation

Figure 3. *Farroceras freucheni* (Teichert). GSC 113686, siphuncle, x1, GSC loc. O-104194 (Putnam Highland).

Figure 4. *Ceraurinus* sp. GSC 113687, pygidium, x2, GSC loc. O-104198 (Silliman's Fossil Mount).

Figure 7. *Kionoceras* sp. GSC 113688, phragmocone, lateral view (venter right), x1, GSC loc. O-104511 (Silliman's Fossil Mount).

Figure 8. *Pseudogygites* sp. aff. *P. latimarginatus* (Hall). GSC 113689, pygidium, x1, GSC loc. O-104507 (Silliman's Fossil Mount).

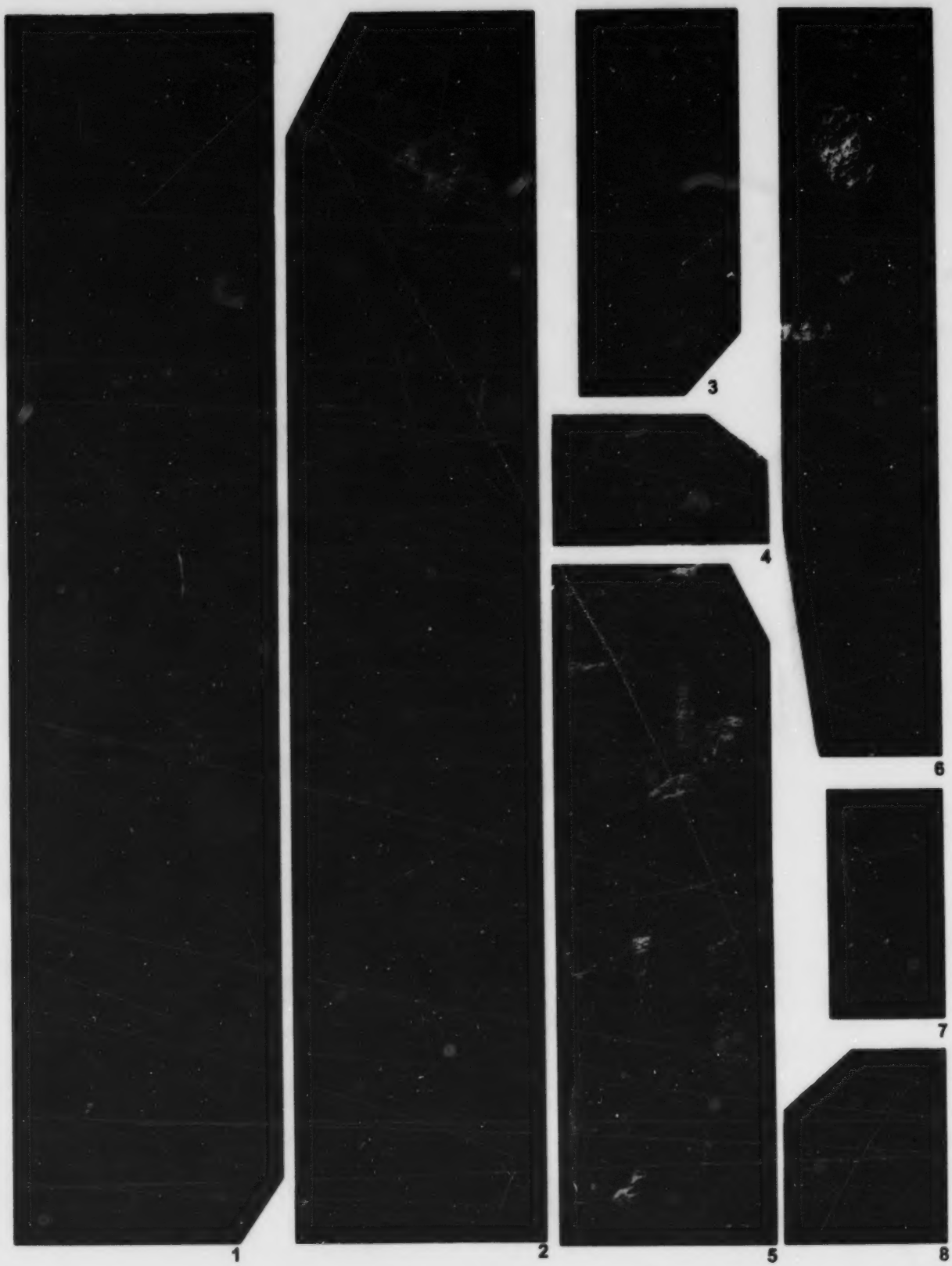
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PLATE 33

Churchill River Group

Figure 1. *Diestoceras pyriforme* Troedsson. GSC 113811, phragmocone and living chamber with apertural outline, x1, GSC loc. 85468, Coats Island.

Figure 3. *Apsidoceras elegans* Troedsson. GSC 113812, phragmocone, x1, GSC loc. 85468.

Amadjuak Formation

Figures 2, 6. *Diestoceras* sp. GSC 113690, lateral (venter left) and ventral views, x1, GSC loc. O-104540 (Jordan River).

Figure 4. *Kionoceras scalariforme* (Schuchert). GSC 113691, phragmocone, x2, GSC loc. O-104507 (Silliman's Fossil Mount).

Figure 5. *Apsidoceras* sp. GSC 113692, phragmocone and living chamber, x1/2, GSC loc. O-104202 (Amadjuak Lake).

Upper Ordovician

Figures 7, 8. *Beloitoceras* sp. GSC 113816, phragmocone, ventral and lateral (venter right) views, x1, Lac Manicouagan, Quebec.

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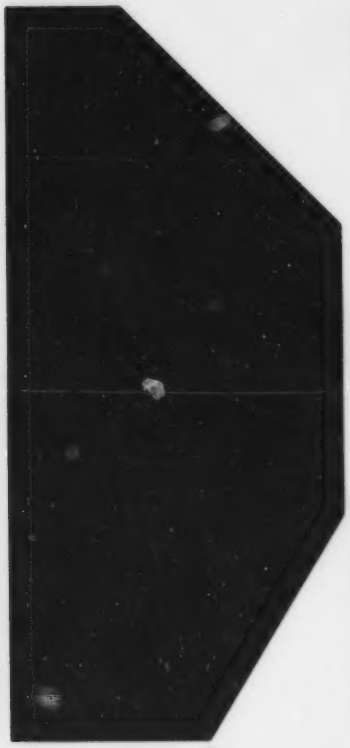

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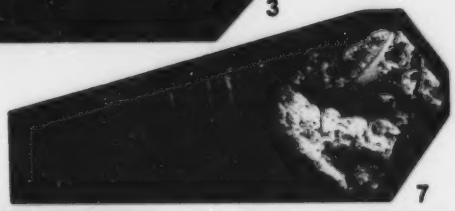

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PLATE 34

Frobisher Bay Formation

Figures 9, 10. *Plectoceras lowi* Foerste. GSC 113694, phragmocone and living chamber, x1/2, and inner three whorls displaying holochoanitic siphuncle, x2, GSC loc. O-104197 (Hone River).

Amadjuak Formation

Figure 1. *Lambeoceras magnum* Troedsson. GSC 113693, phragmocone, x3/4, GSC loc. O-104189 (Hone River).

Figures 2–7. *Probillingsites belli* Miller. GSC 113695–113697, phragmocones, lateral and ventral views, dorsal and ventral views, lateral and ventral views, x1, all GSC loc. O-104198 (Silliman's Fossil Mount).

Figure 8. *Hapsiceraurus hispidus* Whittington. GSC 113698, cephalon and thorax of a partly enrolled specimen, x4, GSC loc. O-104229 (Silliman's Fossil Mount).

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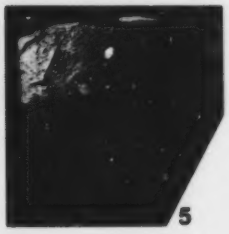
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PLATE 35

Amadjuak Formation

Figure 1. *Neumatoceras* sp. GSC 113699, phragmocone and living chamber, x1, GSC loc. O-104478 (Putnam Highland).

Figure 2. *Ceraurinella* sp. GSC 113700, glabella, x3, GSC loc. O-104204 (Amadjuak Lake).

Figure 3. *Paraharpes arctica* (Whittington). GSC 113701, incomplete cranidium, x2, GSC loc. O-104516 (Silliman's Fossil Mount).

Figures 4, 5. *Westonoceras*(?) sp. GSC 113702, phragmocone, lateral (venter right) and ventral views, x2, GSC loc. O-104198 (Silliman's Fossil Mount).

Figure 6. Cheirurid indeterminate. GSC 113707, pygidium, x2, GSC loc. 104189 (Hone River).

Figure 7. *Denella goodridgii* (Schuchert). GSC 113703, dorsal view of a glabella retaining faint outline of palpebral eye lobes, x6, GSC loc. O-104516 (Silliman's Fossil Mount).

Figures 9, 12. *Beloitoceras gouldi* Foerste. GSC 113704, phragmocone, lateral and septal views, x2, GSC loc. O-104198 (Silliman's Fossil Mount).

Figures 10, 11. *Winnipegoceras royi* Miller. GSC 113705, phragmocone and living chamber, lateral (venter right) and dorsal views, x1, GSC loc. O-104516 (Silliman's Fossil Mount).

Figures 13, 15. *Beloitoceras cornulum* (Schuchert). GSC 113706, phragmocone, septal and lateral (venter right) views, x2, GSC loc. O-104516 (Silliman's Fossil Mount).

Frobisher Bay Formation

Figures 8, 14. *Digenuoceras*(?) sp. GSC 113708, phragmocone, lateral (venter right) and ventral (weathered siphuncle) views, x1, GSC loc. O-104208 (Sylvia Grinnell Lake).

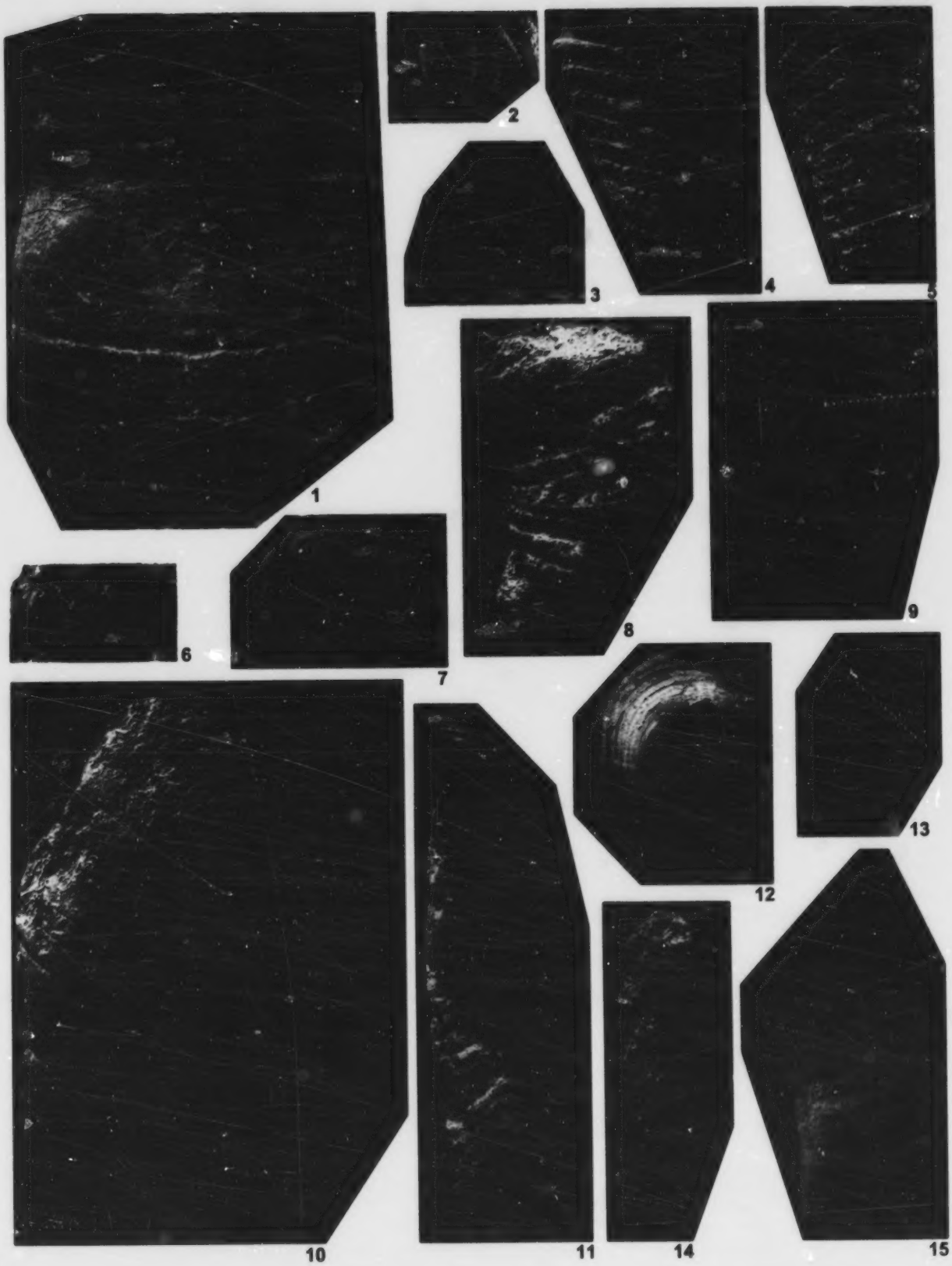
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PLATE 36

Bad Cache Rapids Group

Figures 1, 3. *Cyrtogomphoceras* sp. GSC 113817, 113818, phragmocone and living chamber, lateral (venter right) and lateral (venter left) views, x1, GSC loc. 84561 (Rocky Brook) and 84617 (creek 0.8 km west of Coral Harbour), Southampton Island.

Amadjuak Formation

Figures 2, 4–12. *Anataphrus borraeus* Whittington

2, 6. GSC 113709, ventral with hypostome and dorsal views of unrolled specimen, x1, GSC loc. O-104190 (?talus, Hone River).

4, 5. GSC 113710, dorsal and anterior views of an enrolled specimen, x1, GSC loc. O-104197 (?talus, Hone River).

7–9. GSC 113711, dorsal view of cephalon, anterior view, and dorsal view of pygidium, x2, GSC loc. O-104517 (Silliman's Fossil Mount).

10–12. GSC 113712, dorsal view of cephalon, anterior view, and dorsal view of pygidium, x4, GSC loc. O-104516 (Silliman's Fossil Mount).

Figures 13, 19–21. *Bumastus* (*Bumastoides*) sp.

13. GSC 113713, left lateral view of a rotund enrolled specimen, x1, GSC loc. O-104527 (Silliman's Fossil Mount).

19–21. GSC 113714, dorsal view of thorax, left lateral, and dorsal view of cephalon, x2, GSC loc. O-104516 (Silliman's Fossil Mount).

Figures 22, 23. *Illaenus lacertus* Whittington. GSC 113715, dorsal views of cephalon, and pygidium and thorax, x2, GSC loc. O-104515 (Silliman's Fossil Mount).

Figures 14–18, 24. *Calyptaulax ludvigseni* n. sp.

14, 17, 18. Hypotype, GSC 113716, right lateral, anterior and dorsal views of a cephalon, x3, GSC loc. O-104516 (Silliman's Fossil Mount).

15, 16. Hypotype, GSC 113717, 113718, dorsal views of incomplete cephalons, x3, both GSC loc. O-104517 (Silliman's Fossil Mount).

24. Hypotype, GSC 113719, dorsal view of cephalon and thorax, x3, GSC loc. O-104198 (Silliman's Fossil Mount).

Figure 25. *Nanillaenus punctatus* (Roy). GSC 113720, dorsal view of cranidium, x4, GSC loc. O-104480 (Amadjuak(?) Formation, ?talus, Sylvia Grinnell Lake).

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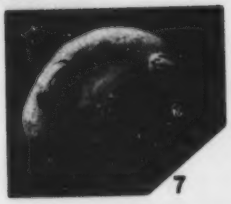
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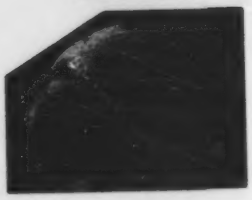
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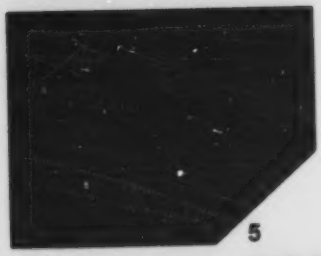
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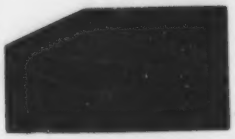
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PLATE 37

Amadjuak Formation

Figure 1. *Calyptaulax ludvigseni* n. sp. GSC 113721, cranidium, x2, GSC loc. O-104492 (Amadjuak(?) Formation, ?talus, Sylvia Grinnell Lake).

Figures 8, 20. *Denella goodridgii* (Schuchert). GSC 113722, 113723, incomplete cephalons, dorsal and oblique anterior views, x2, both GSC loc. O-104516 (Silliman's Fossil Mount).

Figure 9. *Hapsiceraurus hispidus* Whittington. GSC 113724, cephalon and thorax, x1, GSC loc. O-104492 (Amadjuak(?) Formation, ?talus, Sylvia Grinnell Lake).

Figure 12. *Nanillaenus punctatus* (Roy). GSC 113725, cranidium, x3, associated with *Paucicrura* sp. and cranidium of *Cybeloides* sp. (left of *N. punctatus*), GSC loc. O-104492 (Amadjuak(?) Formation, ?talus, Sylvia Grinnell Lake).

Bituminous beds, Amadjuak Formation

Figure 2. *Triarthrus* (*Danarcus*) *glaber* Billings. GSC 113726, x2, GSC loc. O-104539 (Jordan River).

Figures 4–6. *Paucicrura* sp. GSC 113727–113729, x2 (except GSC 113728, x3) all GSC loc. O-104538 (Jordan River).

Figure 7. *Triarthrus* (*Triarthrus*) *eatoni* (Hall). GSC 113730, cranidium with sowerbyellid brachiopod, x3, all GSC loc. O-104539 (Jordan River).

Figures 10, 11, 13–19, 21, 22. *Triarthrus* (*Triarthrus*) *eatoni* (Hall). GSC 113731–113741, cranidia, x4 (fig. 11, 13–15, 17), x2 (Fig. 16 [note associated sowerbyellid brachiopod, pterinid bivalves, gastropod, *Pseudogygites* cranidium], 19), x3 (fig. 10, 18, 21, 22), all GSC loc. O-104539 (Jordan River).

Boas River Formation

Figure 3. *Triarthrus* (*Danarcus*) *glaber* Billings. GSC 41189, x4, Section II-15 feet (4.6 m), Akpatok Island.

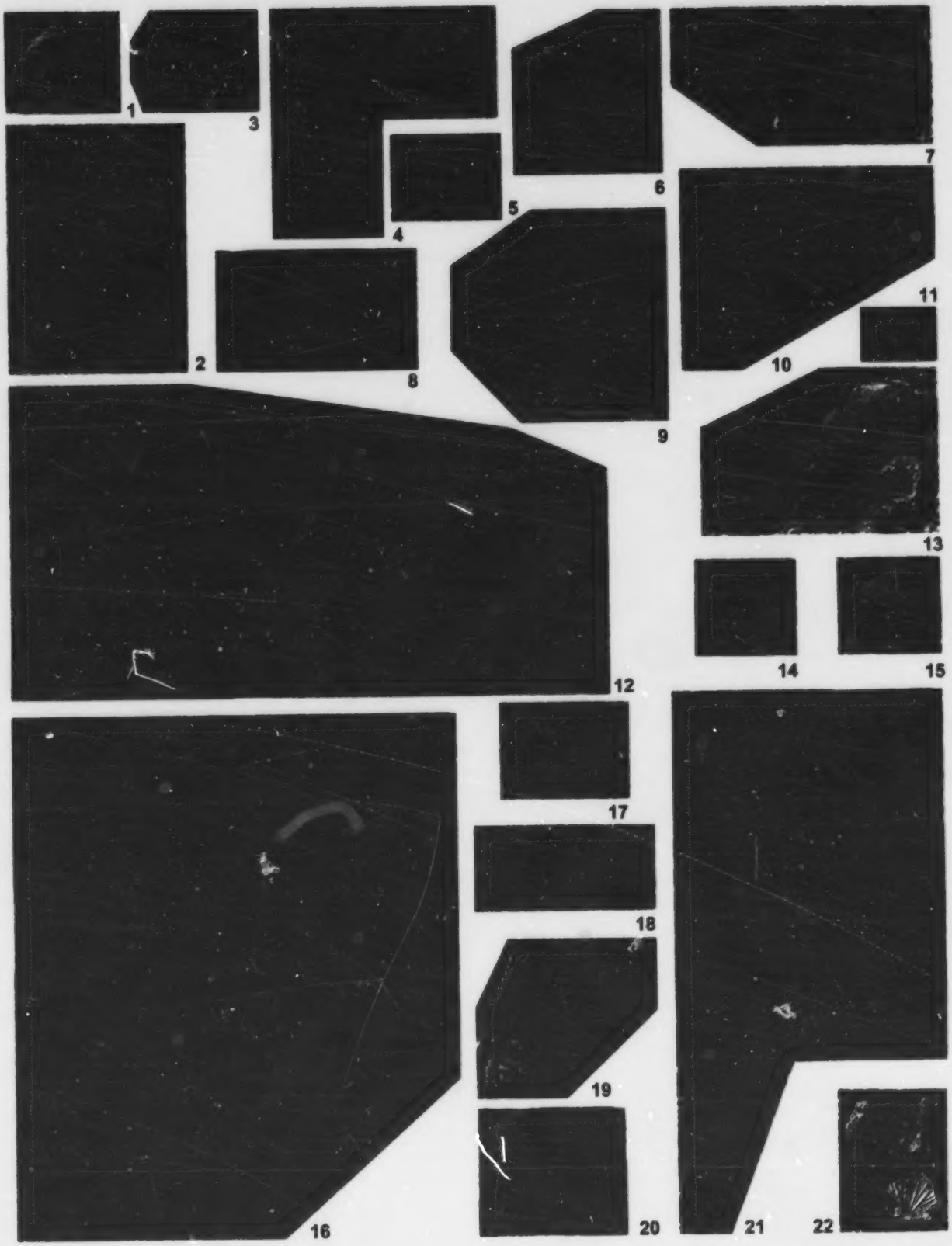
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PLATE 38

Amadjuak Formation

Figures 1–6, 8. *Denella goodridgii* (Schuchert)

1, 5. GSC 113742, dorsal views of pygidium and cranidium-thorax of a partly enrolled specimen, x3, GSC loc. O-104516 (Silliman's Fossil Mount).

2–4. GSC 113743, enrolled specimen dorsal, lateral, and anterior views, x4, GSC loc. O-104516 (Silliman's Fossil Mount).

6, 8. GSC 113744, glabella, dorsal view, and ventral view showing hypostome, x3, GSC loc. O-104517 (Silliman's Fossil Mount).

Figure 7. *Pseudogygites* sp. cf. *P. arcticus* Ludvigsen. GSC 113745, dorsal view of glabella and free cheek, and *Flexicalymene croneisi* (Roy), GSC 113747, x2, GSC loc. O-104540 (Jordan River outlier).

Figure 12. *Pseudogygites* sp. aff. *P. latimarginatus* (Hall). GSC 113746, pygidium, dorsal view, x2, GSC loc. O-104540 (Jordan River outlier).

Bituminous beds, Amadjuak Formation

Figures 10, 11, 14, 16–18. *Pseudogygites arcticus* Ludvigsen.

10, 14, 17. GSC 113748–113750, glabella, dorsal views, x1, all GSC loc. O-104539 (Jordan River outlier).

11, 16, 18. GSC 113751–113753, pygidia, dorsal view of an incomplete specimen, dorsal view of a partly exfoliated specimen [associated forms include smaller *Pseudogygites*, *Triarthrus*, *Geisonoceras*, brachiopod], and ventral view of an external mould [associated forms include a large *Pseudogygites* glabella (upper left) and several smaller pygidia], x1, all GSC loc. O-104539 (Jordan River outlier).

Boas River Formation

Figure 15. *Pseudogygites hudsoni* Ludvigsen. GSC 113819, pygidium, x2, GSC loc. 83176 (Boas River, Southampton Island).

Cape Phillips Formation

Figure 9. *Pseudogygites arcticus* Ludvigsen. GSC 113820, complete specimen, x1, GSC loc. 22315 (southeast tip of Little Cornwallis Island).

Akpatok Formation

Figure 13. *Pseudogygites akpatokensis* Ludvigsen. GSC 113821, pygidium, x1, Section III-60 feet (18.5 m), Akpatok Island.

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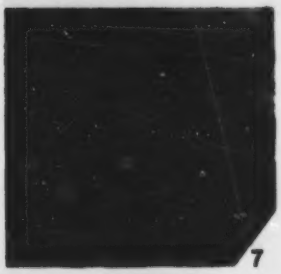
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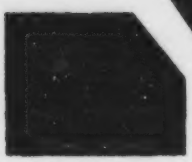
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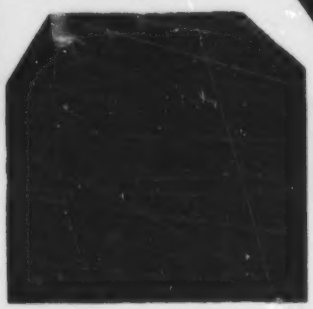
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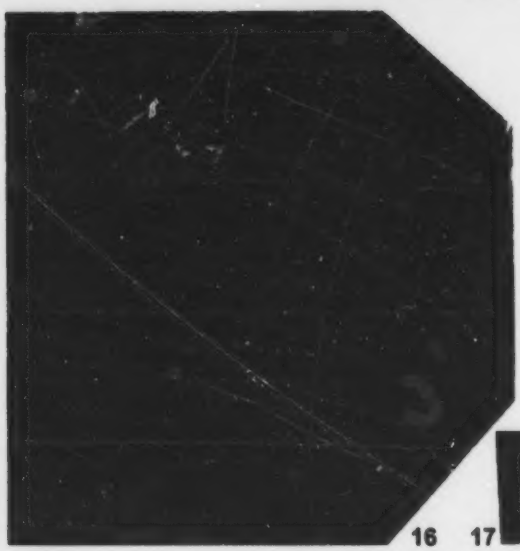
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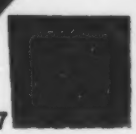
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PLATE 39

Amadjuak Formation

Figures 1, 7. *Rasmussenoceras leveannulatum* (Troedsson). GSC 113754, incomplete phragmocone and body chamber, ventral and dorsal views, x1, GSC loc. O-104202 (west shore Amadjuak Lake).

Figure 4. *Ormoceras*(?) sp. GSC 113755, phragmocone displaying siphuncle, x1, GSC loc. O-104518 (Silliman's Fossil Mount).

Figure 5. *Gorbyoceras baffinense* (Schuchert). GSC 113756, phragmocone, lateral view, x1, GSC loc. O-104193 (unnamed lake, northwest of Sylvia Grinnell Lake) (cf. Miller et al., 1954, Pl. 26, Fig. 3, 4).

Figure 8. *Allumettoceras subequilaterale* Miller. GSC 113760, ventral view, x1, GSC loc. O-104528 (Jordan River).

Frobisher Bay Formation

Figures 2, 3. *Gorbyoceras* sp. GSC 113757, 113758, phragmocones, lateral and dorsal views, x1, GSC loc. O-104197 (Hone River) and O-104208 (Sylvia Grinnell Lake).

Figure 6. *Endoceras chidleyense* Foerste. GSC 113759, phragmocone, dorsal view, x1, GSC loc. O-104530 (Jordan River).

Figure 9. *Actinoceras hanseni* (Foerste). GSC 113761, phragmocone and portion of body chamber, x1, GSC loc. O-104197 (Hone River).

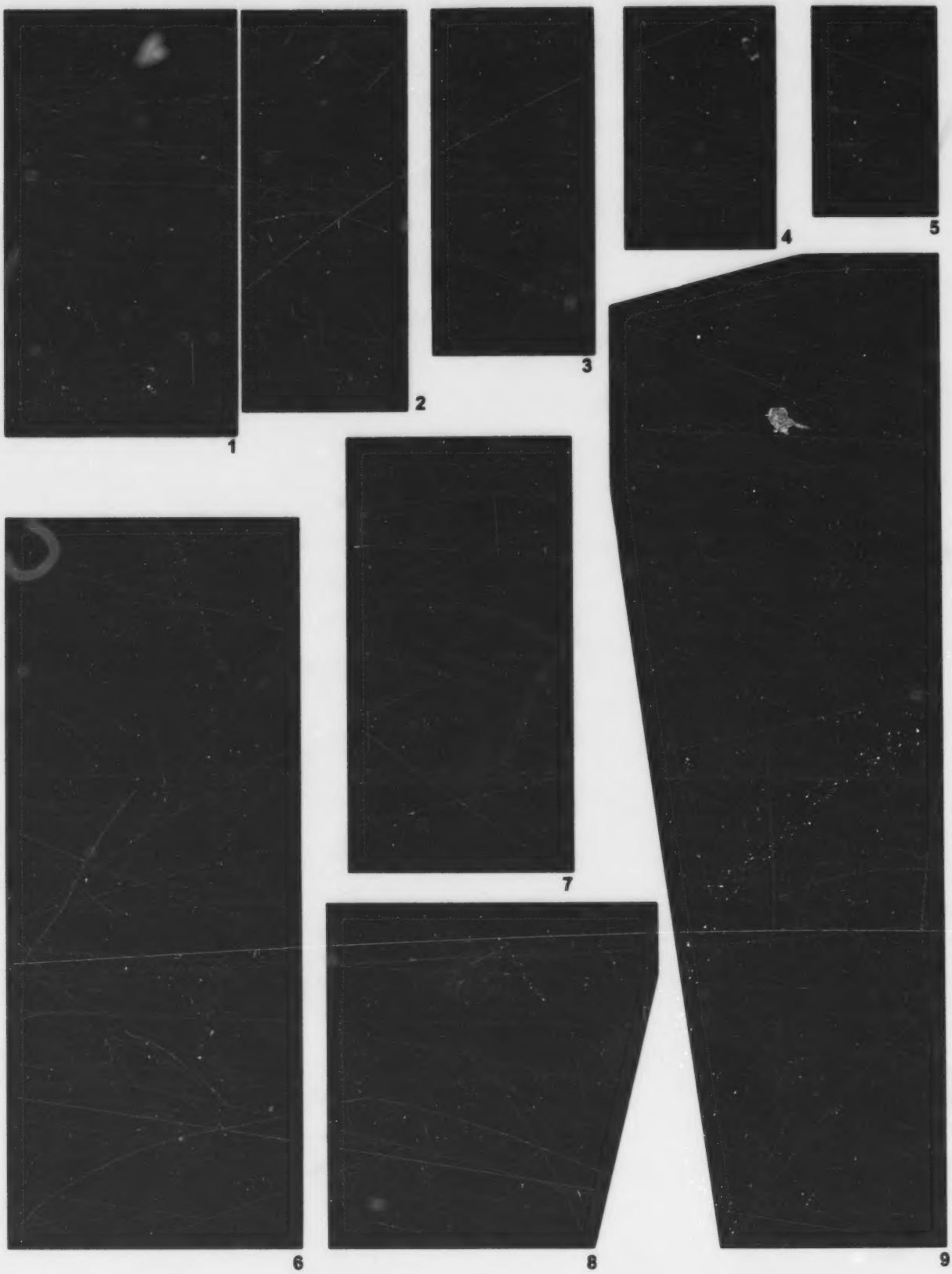
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PLATE 40

Collingwood Formation

Figures 1, 2. *Pseudogygites latimarginatus* (Hall). GSC 1934, 113762, dorsal views of nearly complete specimens, slightly exfoliated, x1 and x3, both GSC loc. 60063 (Collingwood, Ontario).

Cape Phillips Formation

Figures 3–6. *Pseudogygites arcticus* Ludvigsen. GSC 113763, 113764, dorsal views of nearly complete specimens, GSC loc. O-104985 (19.8 m above sea level), GSC 113765, rubber cast of ventral mould of moulted(?) specimen, GSC loc. O-104982 (18-18.2 m above sea level), and GSC 113766, rubber cast of pygidium and thorax, O-104992 (39.1 m above sea level) , x1 (all Truro Island).

Boas River Formation

Figure 7. *Pseudogygites hudsoni* Ludvigsen. GSC 47516, dorsal view moulted specimen, x2, GSC loc. 84651 (Boas River, Southampton Island).

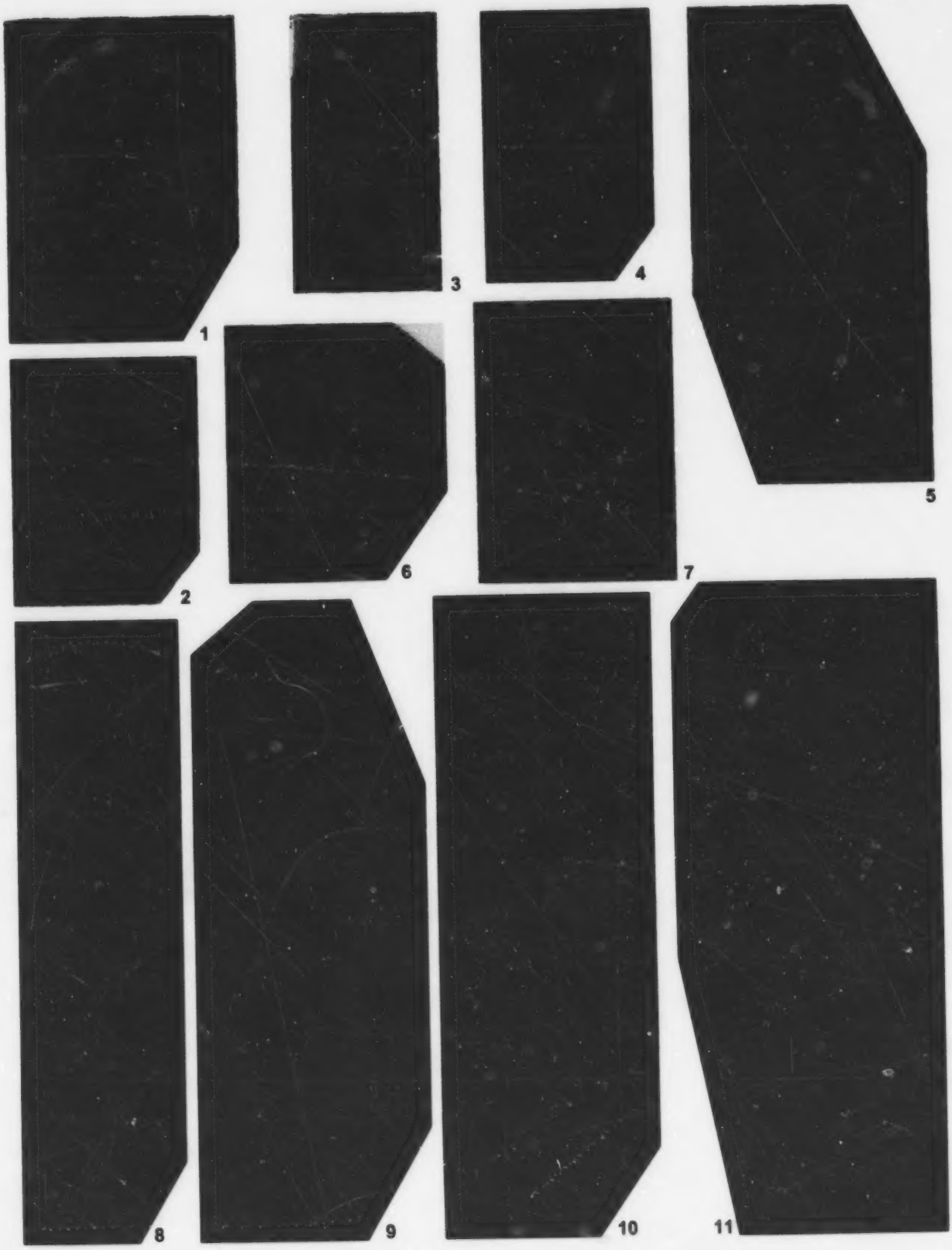
Frobisher Bay Formation

Figures 8, 9. *Ephippiorthoceras* sp. cf. *E. compressum* Foerste. GSC 113767, dorsal and lateral, and venter right views, x1, GSC loc. O-104530 (Jordan River).

Figure 10. *Actinoceras*(?) sp. GSC 113768, partly exfoliated phragmocone, x1, GSC loc. O-104482 (Sylvia Grinnell Lake).

Amadjuak Formation

Figure 11. *Allumettoceras subequilaterale* Miller. GSC 113769, weathered specimen showing siphuncle, x1, GSC loc. O-104194 (Putnam Highland).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MIDDLE AND LATE ORDOVICIAN CONODONTS FROM THE FOXE LOWLAND OF SOUTHERN BAFFIN ISLAND, NUNAVUT

A.D. McCracken[1]

Middle and Late Ordovician conodonts from the Foxe Lowland of southern Baffin Island, Nunavut; ***in*** *Geology and paleontology of the southeast Arctic Platform and southern Baffin Island, Nunavut; Geological Survey of Canada, Bulletin 557, p. 159–216.*

Abstract

The Middle Ordovician Frobisher Bay Formation ranges in age from Rocklandian to late Shermanian based on *Polyplacognathus ramosus*. The conodonts recovered from the Frobisher Bay Formation include *Ansella nevadensis*, *Appalachignathus delicatulus*, *Belodina boltoni* n. sp., *Belodina confluens*, *Parabelodina denticulata*, *Phragmodus undatus*, *Pteracontiodus* sp. A, and *Taoqupognathus philipi*.

Lowest Amadjuak Formation strata contain *Belodina* aff. *arca* and *Yaoxianognathus*? *tunguskaensis*. Latest Mohawkian–early Edenian graptolites occur just above this level. In addition, the lowest beds contain *Amorphognathus superbus*, which indicates a late Shermanian–early Maysvillian age. The mid-Edenian to mid-Maysvillian *Oulodus velicuspis* Zone is recognized higher in the formation. Conodonts include *Belodina arca*, *Belodina lillianae* n. sp., *Culumbodina occidentalis*, *C. penna*, *C.* n. sp. X, *Periodon* aff. *grandis*, *Phragmodus undatus*, *Plectodina tenuis*, *Protopanderodus liripipus*, *Pseudobelodina quadrata*, *Pseudooneotodus mitratus*, *Strachanognathus parvus*, and *Staufferella lindstroemi*. The range is latest Mohawkian–latest Edenian.

Lower Akpatok strata on Akpatok Island are assigned to the *Oulodus velicuspis* Zone. Strata at the top of the formation on Baffin Island contain *Amorphognathus duftonus*, *A. ordovicicus*, *Belodina arca*, *Belodina lillianae* n. sp., *Plegagnathus nelsoni*, *Pseudobelodina v. vulgaris*, and *Staufferella* n. sp. A. *Oulodus rohneri* and *Belodina stonei* are indicative of the Richmondian. The range is latest Edenian–early Richmondian.

Faunas from the uppermost Akpatok and lower Foster Bay formations are similar. The latter is Richmondian. Its fauna includes *Amorphognathus duftonus*, *A. ordovicicus*, *Belodina stonei*, *Belodina* n. sp., *Plegagnathus nelsoni*, *Pseudobelodina v. vulgaris*, and *Staufferella* n. sp. A.

The Late Ordovician faunas contain conodonts characteristic of the Midcontinent and the Atlantic faunal regions. The Australasian Province is recognized on the presence of species of *Taoqupognathus* and *Yaoxianognathus*.

Résumé

En se fondant sur la présence de *Polyplacognathus ramosus*, l'âge de la Formation de Frobisher Bay de l'Ordovicien moyen se situerait entre le Rocklandien et le Shermanien tardif. Les conodontes récoltés dans des unités de la Formation de Frobisher Bay comprennent *Ansella nevadensis*, *Appalachignathus delicatulus*, *Belodina boltoni* n. sp., *Belodina confluens*, *Parabelodina denticulata*, *Phragmodus undatus*, *Pteracontiodus* sp. A, et *Taoqupognathus philipi*.

Les strates basales de la Formation d'Amadjuak ont livré *Belodina* aff. *arca* et *Yaoxianognathus*? *tunguskaensis*. Des graptolites datant du Mohawkien terminal à l'Édénien précoce sont présents immédiatement au-dessus de ce niveau. En outre, les lits à la base de l'unité contiennent *Amorphognathus superbus*, ce qui donne un âge du Shermanien tardif au Maysvillien précoce. Plus haut dans la formation, on distingue la Zone à *Oulodus velicuspis* (Édénien moyen–Maysvillien moyen). Les conodontes comprennent *Belodina arca*, *Belodina lillianae* n. sp., *Culumbodina occidentalis*, *C. penna*, *C.* n. sp. X, *Periodon* aff. *grandis*, *Phragmodus undatus*, *Plectodina tenuis*, *Protopanderodus liripipus*, *Pseudobelodina quadrata*, *Pseudooneotodus mitratus*, *Strachanognathus parvus* et *Staufferella lindstroemi*. L'intervalle va du Mohawkien terminal à l'Édénien terminal.

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Les strates de la partie inférieure de la Formation d'Akpatok dans l'île Akpatok ont été attribuées à la Zone à *Oulodus velicuspis*. Les strates au sommet de cette formation dans l'île de Baffin contiennent *Amorphognathus duftonus*, *A. ordovicicus*, *Belodina arca*, *Belodina lillianae* n. sp., *Plegagnathus nelsoni*, *Pseudobelodina v. vulgaris* et *Staufferella* n. sp. A. *Oulodus rohneri* et *Belodina stonei* indiquent un âge richmondien. L'intervalle va de l'Édénien terminal au Richmondien précoce.

Les faunes provenant du sommet de la Formation d'Akpatok sont semblables à celles de la partie inférieure de la Formation de Foster Bay. Cette dernière remonte au Richmondien. Sa faune inclut *Amorphognathus duftonus*, *A. ordovicicus*, *Belodina stonei*, *Belodina* n. sp., *Plegagnathus nelsoni*, *Pseudobelodina v. vulgaris* et *Staufferella* n. sp. A.

Les faunes de l'Ordovicien tardif contiennent des conodontes qui sont caractéristiques des régions fauniques médio-continentale et atlantique. La province australasienne est révélée par la présence d'espèces de *Taoqupognathus* et de *Yaoxianognathus*.

INTRODUCTION

This report discusses Ordovician conodonts from collections made at seventeen sections on Baffin Island in 1988 and 1989 (Fig. 1). The conodont collections comprise more than 50,000 elements of over 60 species from 70 samples totalling more than 330 kg. A little less than half of these Baffin conodonts are panderodid species and similar genera. These, and related collections from the Akpatok Formation on Akpatok Island, require further, detailed systematic treatment.

PREVIOUS CONODONT STUDIES

Earlier published reports on conodonts from Foxe Basin include the works by Barnes (1974, 1977). All of his (1974) Foxe Basin localities are from the basin's western extremity and represent the lower and upper Ship Point Formation. Barnes (1974) equated the lower and upper parts of this formation with the lower Eleanor River Formation, and upper Eleanor River and lower Bay Fiord formations, respectively, of the Franklinian Miogeosyncline in the Arctic Islands. He (1974, p. 228-229) suggested the lower Ship Point Formation was late Canadian (late Arenigian) in age, and that the upper Ship Point Formation was "late Whiterockian to Porterfieldian (including Chazyan)", that is, late Llanvirn to early Caradoc. These strata are older than those collected for conodonts in this present study. Stratigraphic terms for Foxe Basin and related basins are shown in Figure 2.

Barnes (1974, p. 235) also reported on samples from Southampton, Coats, and White islands in the Hudson Bay Basin. These were assigned to the Bad Cache Rapids Group, Churchill River Group, and Red Head Rapids Formation. From the petroliferous shale on Southampton Island that "lies between the Bad Cache Rapids and Churchill River groups", he identified *Amorphognathus ordovicicus*, *Belodina profunda* (= *Pseudobelodina vulgaris vulgaris*), *Belodina* n. sp. 1 Weyant s.f. (= *Pseudobelodina quadrata*), *Belodina* n. sp. A Sweet et al. s.f. (= *Culumbodina penna*), and *Cordylodus robustus* s.f., *Plegagnathus dartoni* s.f., and *P. nelsoni* s.f., which comprise the multielement species *P. nelsoni* (Sweet, 1979a). In addition, he illustrated *Belodina* n. sp. B from the Thumb Mountain Formation of Bathurst Island, which is regarded as a synonym of *Culumbodina occidentalis* (Sweet, 1979a). In his report, Barnes (1971, p. 1–2) noted that the fauna of the oil shale (thought to be a Collingwood Formation equivalent) was indistinguishable from that of the limestone above (i.e., the Churchill River strata). He further stated that the fauna of the Churchill River Group was similar to a fauna he had studied from Member B, Baillarge Formation, Brodeur Peninsula, Baffin Island (Barnes, 1970).

Twenty-four productive conodont samples (out of fifty in total) from Melville Peninsula, western Foxe Basin, were reported by Barnes (1977). Seven samples of the Ship Point Formation yielded 306 conodonts, which were interpreted as mid-Whiterockian to Marmorian (latest Arenig to Late Llandeilo).

The 545 conodonts from the 17 samples from the Bad Cache Rapids Formation belonged to two assemblages. One was Blackriveran to Kirkfieldian in age, the other Shermanian to Maysvillian. The older fauna included a fragment of *Appalachignathus* sp. Two elements of *Polyplacognathus ramosus* were found in another sample. Other species in these samples include *Eobelodina* sp. s.f. and *Phragmodus undatus*. Species found in both faunas are: *Acodus mutatus* (?= *Besselodus borealis* and/or *Walliserodus amplissimus*), *Belodina compressa* (= *B. confluens*; Sweet, 1979a), *B. dispansa* (= *Pseudobelodina*? *dispansa*), *Drepanoistodus suberectus*, *Panderodus breviusculus* and other *Panderodus* species, *Periodon*

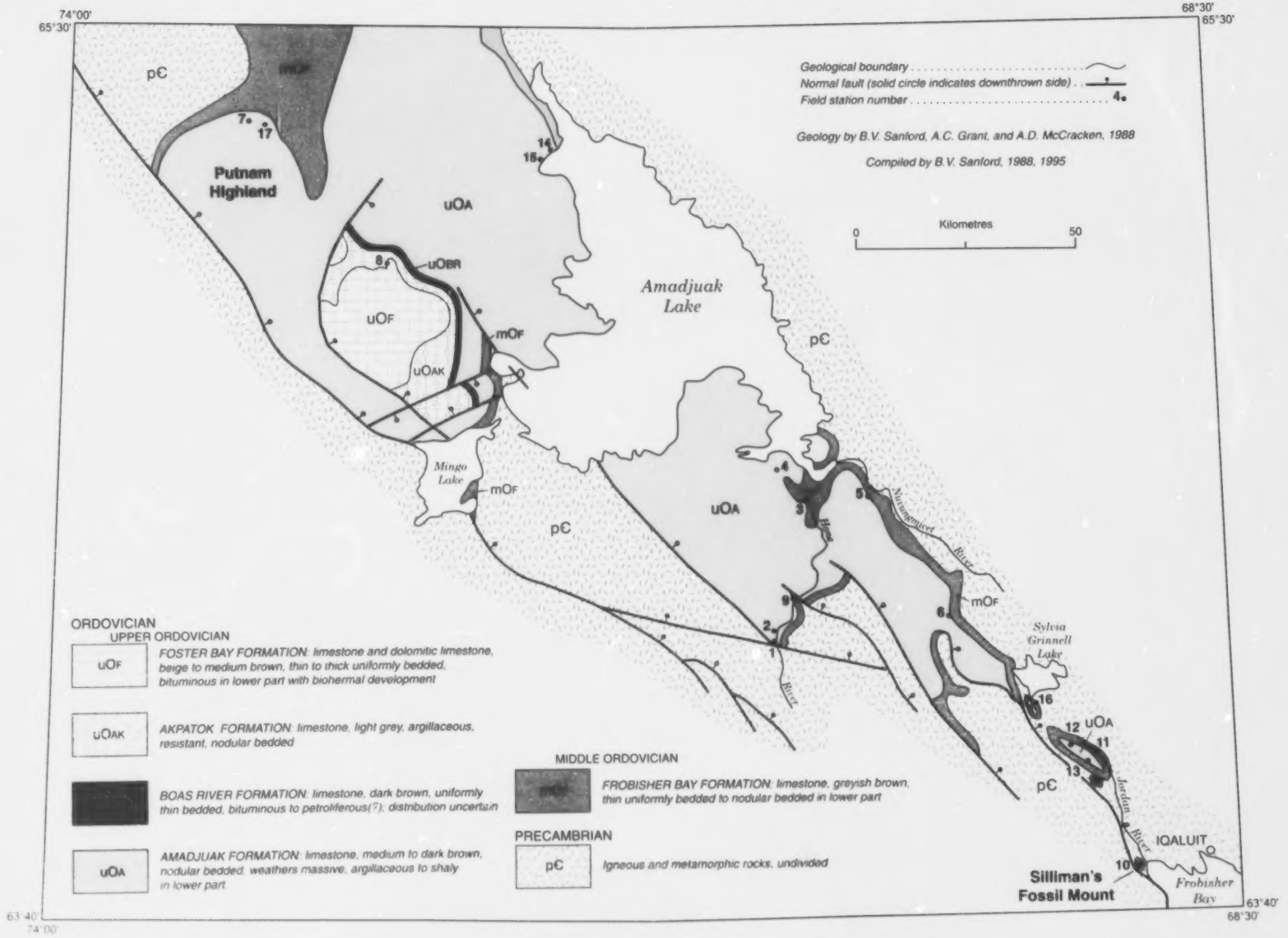

Figure 1. *Collection localities, southern Baffin Island.*

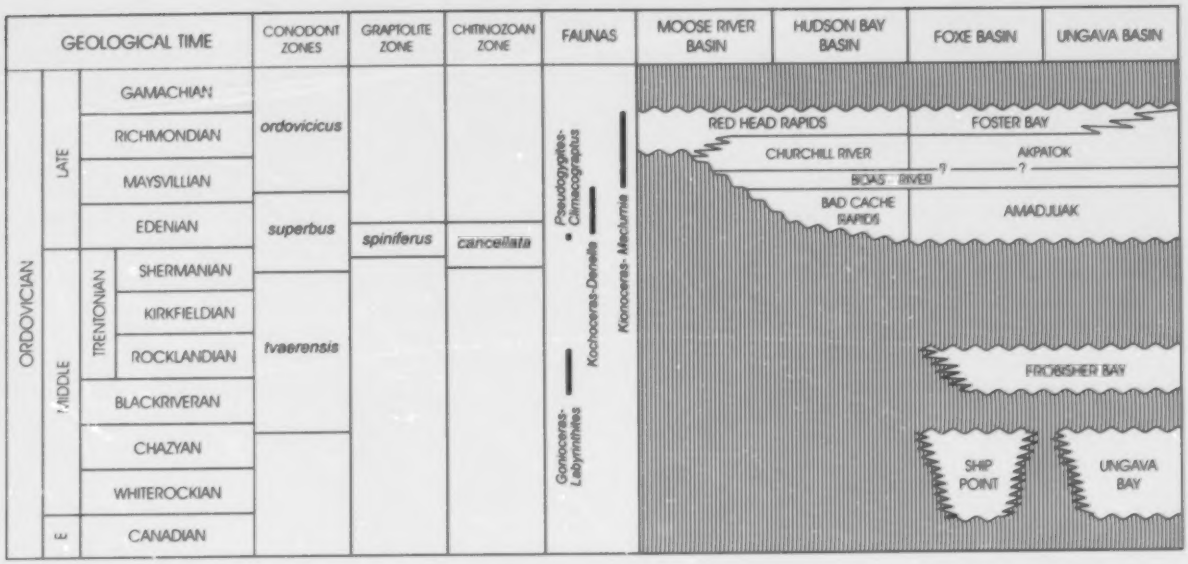

Figure 2. *Stratigraphic nomenclature of Foxe Basin, and correlative strata in adjacent basins.*

grandis (= *P.* aff. *grandis*), and *Staufferella lindstroemi*. Characteristic of the younger fauna were *Belodina lethi* (= *B. arca* and *B. confluens* according to Sweet, 1979a), *B. profunda* (= *Pseudobelodina vulgaris vulgaris*; Sweet, 1979a), *Belodina* n. sp. 1 (= *Pseudobelodina quadrata*; Sweet, 1979a), *Eobelodina* sp. s.f. (?= *Pseudobelodina adentata*; Sweet, 1979a), and *Protopanderodus insculptus* (= *P. liripipus*; McCracken, 1989).

Barnes (*in* Workum et al., 1976) identified and described conodonts from the subsurface of Akpatok Island, Ungava Basin, as being similar to those of the upper Ship Point Formation of the Foxe Basin. Four small surface samples on Akpatok Island yielded a rather undiagnostic fauna of cones: *Drepanoistodus*, *Panderodus*, *Paroistodus venustus* (= *P.* ? sp. A), and *Belodina dispansa* (*Pseudobelodina dispansa*). Only one was thought to have some stratigraphic value: *Panderodus staufferi* (Branson, Mehl and Branson) represented the upper Maysvillian through Richmondian stages.

A Paleozoic outlier north of Aberdeen Lake, Nunavut contained a Late Ordovician fossil assemblage (this location is west of Southampton Island, and about 500 km from Hudson Bay). The conodonts included *Plegagnathus nelsoni* and *Belodina profunda* (= *Pseudobelodina vulgaris vulgaris*; Sweet, 1979a), which suggested to Nowlan (*in* Bolton and Nowlan, 1979) a late Maysvillian to Richmondian age. Bolton and Nowlan correlated these strata to the Churchill River Group of Southampton Island and northern Manitoba. Sweet and Bergström (1984, Table 1) later reassigned the Aberdeen Lake conodonts to the Edenian–Maysvillian *Oulodus velicuspis* Chronozone.

Conodont faunas have been reported in studies on Southampton Island (Heywood and Sanford, 1976; McCracken and Nowlan, 1989). The latter report also included samples from organic-rich beds at two localities in southern Baffin Island that were collected by N.J. McMillan and G. Macauley in 1986 (see Macauley, 1987).

The sample from the Jordan River (GSC loc. C-151097; Section 11A of this study) was dominated by *Phragmodus undatus* Branson and Mehl, and also contained *Periodon grandis* Ethington (= *Periodon* aff. *grandis* herein), and *Protopanderodus liripipus* Kennedy, Barnes and Uyeno, and non-diagnostic species of *Drepanoistodus*, *Panderodus*, and *Paroistodus*? These suggested a Trentonian (Shermanian) to early Maysvillian age for the organic-rich unit on the Jordan River.

The other locality, on the northwestern shore of Amadjuak Lake, contained a more abundant and diverse fauna. Combined, the two samples (GSC loc. C-151098, C-151099; base of Section 14 of this study) contained *Amorphognathus* sp. (species indeterminate because of the lack of diagnostic elements), *Belodina arca*, *Coelocerodontus*? sp. (= the squat, pyramidal elements of *C. trigonius* herein), species of *Panderodus*, *Paroistodus*? sp. A, *Periodon grandis* (= *P.* aff. *grandis*), *Phragmodus undatus*, *Plectodina tenuis*, *Protopanderodus liripipus*, *Pseudobelodina*? *dispansa*, and *Staufferella* sp. (= *S.* n. sp. A

herein). Unlike the collections from Melville Peninsula and Southampton Island (Barnes, 1974, 1977), and Aberdeen Lake (Bolton and Nowlan, 1979), these two collections from Baffin Island lack *Plegagnathus nelsoni* and *Pseudobelodina vulgaris vulgaris*.

McCracken and Nowlan (1989) concluded that the organic-rich beds on Jordan River were likely Shermanian to early Maysvillian in age. The organic-rich unit at Amadjuak Lake was either the same age as the Boas River shale (informal) on Southampton Island ("probably middle Maysvillian"), or "a little older, because the fauna indicates a middle Edenian to middle Maysvillian age" (McCracken and Nowlan, 1989, p. 1888).

ACKNOWLEDGMENTS

Two of the technical staff in the Ottawa office of the Geological Survey of Canada (Calgary) were of great help in this conodont study and indeed in the overall Baffin Island project. Carrie Bolton processed the conodont samples in her usual effective manner. She also alerted Tom Bolton to any macrofossils that were with the bulk conodont–limestone samples. Greg Martin assisted the overall project not only through curation of the samples collected by myself and Sanford, but also by accompanying me as field assistant in 1989. In spite of the short collection time, we collected a large bulk of conodont and megafossil samples. His assistance is much appreciated. I had the honour and pleasure of working with several of the GSC's senior geologists – Bolton, Copeland, Grant, and Sanford. The late Tom Bolton was especially helpful, and a delight to work with.

I value the comments made by Brian Norford and Godfrey Nowlan (both of GSCC), and Jeff Bauer (Shawnee State University) on earlier versions of this paper.

BIOSTRATIGRAPHY

Conodonts were recovered from the four exposed formations on Baffin Island – Frobisher Bay, Amadjuak, Akpatok, and Foster Bay (Fig. 3, Table 1a-h herein; McCracken et al., 1996). Although the Boas River Formation is described by

Tables 1a-h

Stratigraphic distribution of conodonts and other phosphatic microfossils in seventeen sections through four exposed formations, southern Baffin Island. Formation symbols are: FR = Frobisher Bay, AM = Amadjuak, AK = Akpatok, FO = Foster Bay

Table 1a

S1–S7 GSC locality number	O-104209	O-104210	O-104211	O-104212	O-104213	O-104214	O-104215	O-104216	O-104217	O-104218	O-104219	O-104220	O-104222	Totals
Formation	AM	AM?	AM	AM	FR	FR	FR?	AM	AM	AM	AM	AM	AM	
Mass (grams)	4300	4410	3605	3540	4360	4100	3325	3620	3900	4310	4715	3845	5040	53070
Percent dissolved	92	100	100	100	100	100	100	100	100	100	100	100	94	99
Section number	S1	S1	S2	S2	S3	S3	S4	S4	S5	S6	S7	S7	S7	
Species/collection level (m)	1.50	15.50	1.00	12-15	0.30	3.00	3.90	13.75	0.70	0.00	0.40	1.00	4.90	
ambalodiform element							1							1
Amorphognathus tvaerensis?														0
Amorphognathus duftonus														0
Amorphognathus superbus		4												4
Amorphognathus ordovicicus														0
Ansella nevadensis					3	1	1							5
Aphelognathus politus														0
Appalachignathus delicatulus					5	8	1							14
Belodina arca				1							4			5
Belodina aff. *arca*														0
Belodina boltoni n. sp.					2	2	1							5
Belodina confluens	2			2	1	2		3	1	2	36	6	3	58
Belodina lillianae n. sp.														0
Belodina stonei														0
Belodina n. sp. Y		1												1

Table 1a (cont.)

S1–S7 GSC locality number	O-104209	O-104210	O-104211	O-104212	O-104213	O-104214	O-104215	O-104216	O-104217	O-104218	O-104219	O-104220	O-104222	Totals
Formation	**AM**	**AM?**	**AM**	**AM**	**FR**	**FR**	**FR?**	**AM**	**AM**	**AM**	**AM**	**AM**	**AM**	
Belodina? n. sp. B														0
Belodina? n. sp. X														0
Besselodus borealis														0
Coelocerodontus trigonius											4			4
Culumbodina occidentalis	1													1
Culumbodina penna	1													1
Culumbodina n. sp. X														0
Drepanoistodus suberectus	5	6	3	6	4	16	1				28	5	7	81
Milaculum ethinclarki										3				3
Milaculum sp. A						2	1							3
Milaculum sp. B														0
Milaculum sp. C														0
Milaculum sp. D														0
N. Gen. A n. sp. A *sensu* McCracken														0
Oulodus rohneri														0
Oulodus velicuspis								1						1
Oulodus? sp.														0
Panderodus spp.		82	21	27	31	42	18	18	4	6	624	90	108	1071
Panderodus bergstroemi													2	2
Panderodus breviusculus														0
Panderodus feulneri	11													11
Panderodus gibber														0
Panderodus gracilis														0
Panderodus serratus?														0
Parabelodina denticulata														0
Paroistodus? sp. A			1		1		1				10	1		14
Periodon aff. *grandis*				2							23	2	6	33
Phosphannulus universalis			1	1							1	1		4
Phragmodus undatus s.l.											30	7	4	41
Plectodina aculeata														0
Plectodina tenuis	1		3	2						3	1	8	7	25
Plectodina sp.				3										3
Plegagnathus nelsoni		7												7
Polyplacognathus ramosus						8								8
Prioniodus sp.														0
Protopanderodus liripipus				1										1
Pseudobelodina adentata?					1	2								3
Pseudobelodina? dispansa				1			1				15	2		19
Pseudobelodina inclinata														0
Pseudobelodina quadrata											1			1
Pseudobelodina v. vulgaris														0
Pseudobelodina aff. vulgaris					3		1				3			7
Pseudooneotodus aff. beckmanni														0
Pseudooneotodus mitratus														0
Pseudooneotodus sp.														0
Pteracontiodus sp. A						2	11							13
Ptiloncodus harrisi					1	2								3
Strachanognathus parvus														0
Staufferella lindstroemi											5		1	6

Table 1a (cont.)

S1–S7 GSC locality number	O-104209	O-104210	O-104211	O-104212	O-104213	O-104214	O-104215	O-104216	O-104217	O-104218	O-104219	O-104220	O-104222	Totals
Formation	**AM**	**AM?**	**AM**	**AM**	**FR**	**FR**	**FR?**	**AM**	**AM**	**AM**	**AM**	**AM**	**AM**	
Staufferella n. sp. A														0
Taoqupognathus philipi														0
Ulrichodina? sp.														0
Walliserodus amplissimus			2	1	7		1	1			9			21
Yaoxiangognathus? *tunguskaensis*														0
Zanklodus sp.														0
indet. oistodiform element							1							1
indet. hook with base														0
indet. serrated sym. element														0
indet. cordylodiform element														0
indet. eobelodiniform element						1								1
TOTALS	21	100	31	47	59	88	40	23	5	14	794	122	138	1461

Table 1b

S8 GSC locality number	O-104500	O-104502	O-104223	O-104224	O-104503	O-104504	O-104225	Totals
Formation	**AK**	**AK**	**AK**	**FO**	**FO**	**FO**	**FO**	
Mass (grams)	5660	5960	4945	5595	5725	4910	4215	37010
Percent dissolved	97	96	96	98	100	98	100	98
Section number	S8	S8	S8	S8	S8	S8	S8	
Species/collection level (m)	1.30	2.40	3.32	3.47	4.00	6.00	Talus	
ambalodiform element								0
Amorphognathus tvaerensis?								0
Amorphognathus duftonus	0	1	16	2			0	19
Amorphognathus ordovicicus	96	283	663		741		556	2339
Amorphognathus superbus								0
Ansella nevadensis								0
Aphelognathus politus								0
Appalachignathus delicatulus								0
Belodina arca		1						1
Belodina aff. *arca*								0
Belodina boltoni n. sp.								0
Belodina confluens								0
Belodina lillianae n. sp.	0	62	14		2		17	95
Belodina stonei	0	111	207		5		147	470
Belodina n. sp. Y								0
Belodina? n. sp. B								0
Belodina? n. sp. X								0
Besselodus borealis	3	20	34		88		87	232
Coelocerodontus trigonius	16	21	124		261		78	500
Culumbodina occidentalis								0
Culumbodina penna	1							1
Culumbodina n. sp. X								0
Drepanoistodus suberectus	76	255	293		116		398	1138
Milaculum ethinclarki	0	16	10		1		0	27
Milaculum sp. A								0
Milaculum sp. B								0

Table 1b (cont.)

SS GSC locality number	O-104500	O-104502	O-104223	O-104224	O-104503	O-104504	O-104225	Totals
Formation	**AK**	**AK**	**AK**	**FO**	**FO**	**FO**	**FO**	
Milaculum sp. C								0
Milaculum sp. D								0
N. Gen. A n. sp. A *sensu* McCracken		0	1	1	0			2
Oulodus rohneri	0	47	0		0		0	47
Oulodus velicuspis								0
Oulodus? sp.	1	0	4		0		3	8
Panderodus spp.	748	2018	2266		1234		2584	8850
Panderodus bergstroemi								0
Panderodus breviusculus	3							3
Panderodus feulneri								0
Panderodus gibber	10	28	30		10		40	118
Panderodus gracilis								0
Panderodus serratus?								0
Parabelodina denticulata								0
Paroistodus? sp. A	5	155	166		604		827	1757
Periodon aff. *grandis*								0
Phosphannulus universalis	1	7	16		8		17	49
Phragmodus undatus s.l.								0
Plectodina aculeata								0
Plectodina tenuis								0
Plectodina sp.								0
Plegagnathus nelsoni	28	42	77		20		91	258
Polyplacognathus ramosus								0
Prioniodus sp.								0
Protopanderodus liripipus	0	0	1		0		0	1
Pseudobelodina adentata?								0
Pseudobelodina? *dispansa*	12	49	51		167		75	354
Pseudobelodina inclinata	0	2	0		0		0	2
Pseudobelodina quadrata								0
Pseudobelodina v. vulgaris	12	31	13		15		52	123
Pseudobelodina aff. *vulgaris*								0
Pseudooneotodus aff. *beckmanni*	6	6	24		16		3	55
Pseudooneotodus mitratus	9	21	17		6		25	78
Pseudooneotodus sp.	0	10	12		2		5	29
Pteracontiodus sp. A								0
Ptiloncodus harrisi								0
Strachanognathus parvus								0
Staufferella lindstroemi								0
Staufferella n. sp. A	0	0	4		1		5	10
Taoqupognathus philipi								0
Ulrichodina? sp.								0
Walliserodus amplissimus	5	42	37		102		105	291
Yaoxiangognathus? *tunguskaensis*								0
Zanklodus sp.	52	7		0		1	64	
indet. oistodiform element								0
indet. hook with base								0
indet. serrated sym. element								0
indet. cordylodiform element								
indet. eobelodiniform element								
TOTALS	3281	4087	0	3401	0	0	5118	16923

Table 1c

S9 GSC locality number	O-104226	O-104227	O-104228	Totals
Formation	**FR**	**FR**	**FR**	
Mass (grams)	3910	4230	3900	12040
Percent dissolved	100	100	100	100
Section number	S9	S9	S9	
Species/collection level (m)	2.00	5.50	9.50	
ambalodiform element				0
Amorphognathus tvaerensis?				0
Amorphognathus duftonus				0
Amorphognathus ordovicicus				0
Amorphognathus superbus				0
Ansella nevadensis	4	5		9
Aphelognathus politus				0
Appalachignathus delicatulus	6	1	1	8
Belodina arca				0
Belodina aff. *arca*				0
Belodina boltoni n. sp.		4	2	6
Belodina confluens	4	12	3	19
Belodina lillianae n. sp.				0
Belodina stonei				0
Belodina n. sp. Y				0
Belodina? n. sp. B				0
Belodina? n. sp. X				0
Besselodus borealis				0
Coelocerodontus trigonius		1		1
Culumbodina occidentalis				0
Culumbodina penna				0
Culumbodina n. sp. X				0
Drepanoistodus suberectus	2	22	7	31
Milaculum ethinclarki				0
Milaculum sp. A		8		8
Milaculum sp. B		1		1
Milaculum sp. C				0
Milaculum sp. D				0
N. Gen. A n. sp. A *sensu* McCracken				0
Oulodus rohneri				0
Oulodus velicuspis				0
Oulodus? sp.				0
Panderodus spp.	49	94	22	165
Panderodus bergstroemi				0
Panderodus breviusculus				0
Panderodus feulneri				0
Panderodus gibber				0
Panderodus gracilis				0
Panderodus serratus?				0
Parabelodina denticulata				0
Paroistodus? sp. A	4	3	5	12
Periodon aff. *grandis*	6			6
Phosphannulus universalis		1		1
Phragmodus undatus s.l.				0
Plectodina aculeata				0

Table 1c (cont.)

S9 GSC locality number	O-104226	O-104227	O-104228	Totals
Formation	FR	FR	FR	
Plectodina tenuis				0
Plectodina sp.				0
Plegagnathus nelsoni				0
Polyplacognathus ramosus	4	4	6	14
Prioniodus sp.				0
Protopanderodus liripipus				0
Pseudobelodina adentata?	1	2		3
Pseudobelodina? dispansa	2			2
Pseudobelodina inclinata				0
Pseudobelodina quadrata				0
Pseudobelodina v. vulgaris				0
Pseudobelodina aff. vulgaris		2	1	3
Pseudooneotodus aff. beckmanni				0
Pseudooneotodus mitratus				0
Pseudooneotodus sp.				0
Pteracontiodus sp. A	11		1	12
Ptiloncodus harrisi	2	7	1	10
Strachanognathus parvus				0
Staufferella lindstroemi				0
Staufferella n. sp. A				0
Taoqupognathus philipi				0
Ulrichodina? sp.				0
Walliserodus amplissimus	1	11	6	18
Yaoxiangognathus? tunguskaensis				
Zanklodus sp.				0
indet. oistodiform element	1	2		3
indet. hook with base			1	1
indet. serrated sym. element				0
indet. cordylodiform element				0
indet. eobelodiniform element				0
TOTALS	97	180	56	333

Table 1d

S10 GSC locality number	O-104508	O-104509	O-104230	O-104510	O-104229	O-104232	O-104513	O-104514	O-104519	O-104521	O-104522	O-104524	O-104234	O-104233	O-104235	Totals
Formation	AM	AM	AM	AM	AM	AM	AM	AM	AM	AM	AM	AM	AM	AM	AM	
Mass (grams)	2695	6185	6160	6045	5250	5870	4810	1160	1275	5450	3110	5880	5015	4915	5120	68940
Percent dissolved	100	100	94	100	95	95	94	89	86	100	92	98	100	100	97	96
Section number	S10	S10	S10	S10	S10	S10	S10	S10	S10	S10	S10	S10	S10	S10	S10	
Species/collection level (m)	0.17	0.2	0.2	2.6	18	18	18	18	26	31.45	31.5	68.5	72.5	76.5	76.5	
ambalodiform element																0
Amorphognathus tvaerensis?																0
Amorphognathus duftonus																0
Amorphognathus ordovicicus																0
Amorphognathus superbus																0
Ansella nevadensis																0
Aphelognathus politus																0

Table 1d (cont.)

S10 GSC locality number	O-104508	O-104509	O-104230	O-104510	O-104229	O-104232	O-104513	O-104514	O-104519	O-104521	O-104522	O-104524	O-104234	O-104233	O-104235	Totals
Formation	**AM**	**AM**	**AM**	**AM**	**AM**	**AM**	**AM**	**AM**	**AM**	**AM**	**AM**	**AM**	**AM**	**AM**	**AM**	
Appalachignathus delicatulus																0
Belodina arca	5	1	4	28	2	3	2		2	13	4					64
Belodina aff. *arca*																0
Belodina boltoni n. sp.																0
Belodina confluens	44	9	13	96	13	14	14	1	2	36	16	1	1		1	261
Belodina lillianae n. sp.	11		1	28		2				3						45
Belodina stonei																0
Belodina n. sp. Y																0
Belodina? n. sp. B																0
Belodina? n. sp. X																0
Besselodus borealis	3		3	52	2	2	1			3	2					68
Coelocerodontus trigonius		1		7	1	1	1			3						14
Culumbodina occidentalis																0
Culumbodina penna										5						5
Culumbodina n. sp. X																0
Drepanoistodus suberectus	19	3	7	101	22	20	14	8	5	132	46	3	3			383
Milaculum ethinclarki				2		8	1			18	5		1			35
Milaculum sp. A					7											7
Milaculum sp. B						1										1
Milaculum sp. C																0
Milaculum sp. D																0
N. Gen. A n. sp. A *sensu* McCracken																0
Oulodus rohneri																0
Oulodus velicuspis				2						4	1					7
Oulodus? sp.																0
Panderodus spp.	113	26	65	668	231	312	157	56	24	444	294	93	44	15	14	2556
Panderodus bergstroemi						2	2			7	6					17
Panderodus breviusculus				1												1
Panderodus feulneri																0
Panderodus gibber																0
Panderodus gracilis																0
Panderodus serratus?																0
Parabelodina denticulata																0
Paroistodus? sp. A	6	6	28	76	3	5	7			6	3	1		1		142
Periodon aff. *grandis*	75	28	39	219	4	6	13	2	2	31	10					429
Phosphannulus universalis	1	1		6	1											9
Phragmodus undatus s.l.	218	75	107	793	1		1			4	5					1204
Plectodina aculeata	3	1		7												11
Plectodina tenuis		6	22	69	6	3	3	3	3	20	3					138
Plectodina sp.																0
Plegagnathus nelsoni																0
Polyplacognathus ramosus																0
Prioniodus sp.																0
Protopanderodus liripipus					2	1	2				1				1	7
Pseudobelodina adentata?																0
Pseudobelodina? *dispansa*	5	1	2	22	7	6	2			9		2				56
Pseudobelodina inclinata																0

Table 1d (cont.)

S10 GSC locality number	O-104508	O-104509	O-104230	O-104510	O-104229	O-104232	O-104513	O-104514	O-104519	O-104521	O-104522	O-104524	O-104234	O-104233	O-104235	Totals
Formation	**AM**	**AM**	**AM**	**AM**	**AM**	**AM**	**AM**	**AM**	**AM**	**AM**	**AM**	**AM**	**AM**	**AM**	**AM**	
Pseudobelodina quadrata										2						2
Pseudobelodina v. vulgaris																0
Pseudobelodina aff. vulgaris																0
Pseudooneotodus aff. beckmanni				3	4											7
Pseudooneotodus miiratus	1						1			1						3
Pseudooneotodus sp.				2						1						3
Pteracontiodus sp. A																0
Ptiloncodus harrisi																0
Strachanognathus parvus																0
Staufferella lindstroemi	1	1	1	10	1	3										17
Staufferella n. sp. A																0
Taoqupognathus philipi																0
Ulrichodina? sp.																0
Walliserodus amplissimus	4	1		33	11	8	9		2	10		1			1	80
Yaoxiangognathus? *tunguskaensis*											1					1
Zanklodus sp.																0
indet. oistodiform element																0
indet. hook with base																0
indet. serrated sym. element																0
indet. cordylodiform element																0
indet. eobelodiniform element																0
TOTALS	509	160	295	2226	314	397	230	70	40	752	397	101	49	16	17	5573

Table 1e

S11/11A GSC locality number	O-104236	O-104531	O-104532	O-104237	O-104533	O-104534	O-104238	O-104535	O-104536	O-104539	O-104541	Totals
Formation	**FR**	**FR**	**FR**	**FR**	**FR**	**FR**	**FR**	**FR**	**AM**	**AM**	**AM**	
Mass (grams)	4750	5840	5815	5150	6120	5670	5105	6050	5650	na	665	50815
Percent dissolved	94	97	97	100	95	98	100	97	99	na	89	
Section number	S11	S11	S11	S11	S11	S11	S11	S11	S11A	S11A	S11A	
Species/collection level (m)	0.50	0.25	1.45	2.00	2.45	4.00	4.50	4.90	3.00	6.50	11.00	
ambalodiform element					1							1
Amorphognathus tvaerensis?			2									2
Amorphognathus duftonus												0
Amorphognathus ordovicicus												0
Amorphognathus superbus									1			1
Ansella nevadensis	8	11	1	2	1	1	1					25
Aphelognathus politus												0
Appalachignathus delicatulus	1	8	14	3	2	6		4				38
Belodina arca									2			2
Belodina aff. arca									3			3
Belodina boltoni n. sp.	3	6	1		3		3					16
Belodina confluens	1	5	9	2	4	6		5	889		60	981
Belodina lillianae n. sp.												0
Belodina stonei												0
Belodina n. sp. Y												0
Belodina? n. sp. B												0

Table 1e (cont.)

S11/11A GSC locality number	O-104236	O-104531	O-104532	O-104237	O-104533	O-104534	O-104238	O-104535	O-104536	O-104539	O-104541	Totals
Formation	**FR**	**FR**	**FR**	**FR**	**FR**	**FR**	**FR**	**FR**	**AM**	**AM**	**AM**	
Belodina? n. sp. X												0
Besselodus borealis									705			705
Coelocerodontus trigonius									207		10	217
Culumbodina occidentalis												0
Culumbodina penna												0
Culumbodina n. sp. X												0
Drepanoistodus suberectus	2	9	18	20	3	3	6		586	30	35	712
Milaculum ethinclarki									4			4
Milaculum sp. A	1	3			4							8
Milaculum sp. B												0
Milaculum sp. C												0
Milaculum sp. D									359			359
N. Gen. A n. sp. A *sensu* McCracken												0
Oulodus rohneri												0
Oulodus velicuspis												0
Oulodus? sp.									5			5
Panderodus spp.	12	52	95	15	20	70	8	53	4828	64	160	5377
Panderodus bergstroemi									3			3
Panderodus breviusculus												0
Panderodus feulneri												0
Panderodus gibber									128			128
Panderodus gracilis												0
Panderodus serratus?	1								181			182
Parabelodina denticulata												0
Paroistodus? sp. A	1	4	3		1	10		2	1707	49	86	1863
Periodon aff. *grandis*					2				5168	371	58	5599
Phosphannulus universalis									65			65
Phragmodus undatus s.l.	2						1		1094	322	332	1751
Plectodina aculeata												0
Plectodina tenuis									16	1	8	25
Plectodina sp.												0
Plegagnathus nelsoni												0
Polyplacognathus ramosus	2	10	33		1	6	1	6				59
Prioniodus sp.				1								1
Protopanderodus liripipus									163	21	20	204
Pseudobelodina adentata?					3				3			6
Pseudobelodina? *dispansa*		2		1	1				224		5	233
Pseudobelodina inclinata												0
Pseudobelodina quadrata												0
Pseudobelodina v. vulgaris												0
Pseudobelodina aff. *vulgaris*		1	1									2
Pseudooneotodus aff. *beckmanni*									16	3	1	20
Pseudooneotodus mitratus									4			4
Pseudooneotodus sp.									4			4
Pteracontiodus sp. A	1	4	5			1	4					15
Ptiloncodus harrisi		2	4		1							7
Strachanognathus parvus									1			1
Staufferella lindstroemi									43		1	44
Staufferella n. sp. A												0

Table 1e (cont.)

S11/11A GSC locality number	O-104236	O-104531	O-104532	O-104237	O-104533	O-104534	O-104238	O-104535	O-104536	O-104539	O-104541	Totals
Formation	**FR**	**FR**	**FR**	**FR**	**FR**	**FR**	**FR**	**FR**	**AM**	**AM**	**AM**	
Taoqupognathus philipi									1			1
Ulrichodina? sp.					1							1
Walliserodus amplissimus	1	2	15		3	5	1	3	398		2	430
Yaoxiangognathus? *tunguskaensis*									79			79
Zanklodus sp.												0
indet. oistodiform element									7			7
indet. hook with base	4	2		3	2		2					13
indet. serrated sym. element												0
indet. cordylodiform element												0
indet. eobelodiniform element												0
TOTALS	21	116	223	42	41	125	12	90	16894	861	778	19203

Table 1f

S12 - 15 GSC locality number	O-104239	O-104240	O-104241	O-104242	O-104243	O-104245	O-104248	O-104250	O-104249	Totals
Formation	**AM**	**AM**	**AM**	**AM**	**AM**	**AM**	**AM**	**AM**	**AM**	
Mass (grams)	4875	4765	5305	5080	5180	5530	3400	4650	4680	43465
Percent dissolved	100	100	100	100	100	100	54	100	100	95
Section number	S12	S12	S13	S13	S13	S14	S14	S15	S15	
Species/collection level (m)	0.00	10.00	0.45	16.00	21.00	1.85	4.1	24	30	
ambalodiform element										0
Amorphognathus tvaerensis?										0
Amorphognathus duftonus										0
Amorphognathus ordovicicus										0
Amorphognathus superbus							22			22
Ansella nevadensis										0
Aphelognathus politus	1									1
Appalachignathus delicatulus										0
Belodina arca	5					21	1			27
Belodina aff. *arca*										0
Belodina boltoni n. sp.										0
Belodina confluens	1	1	16		1	4	22	18	9	72
Belodina lillianae n. sp.				3				4	6	13
Belodina stonei										0
Belodina n. sp. Y										0
Belodina? n. sp. B						3				3
Belodina? n. sp. X			1							1
Besselodus borealis						2				2
Coelocerodontus trigonius								1		1
Culumbodina occidentalis										0
Culumbodina penna										0
Culumbodina n. sp. X			3							3
Drepanoistodus suberectus	1	4	96	9	3	113	383	53	23	685
Milaculum ethinclarki		2	6		1	4		6	15	36
Milaculum sp. A										0
Milaculum sp. B										0
Milaculum sp. C										0

Table 1f (cont.)

S12 - 15 GSC locality number	O-104239	O-104240	O-104241	O-104242	O-104243	O-104245	O-104248	O-104250	O-104249	Totals
Formation	**AM**	**AM**	**AM**	**AM**	**AM**	**AM**	**AM**	**AM**	**AM**	
Milaculum sp. D										0
N. Gen. A n. sp. A *sensu* McCracken										0
Oulodus rohneri										0
Oulodus velicuspis								10		10
Oulodus? sp.										0
Panderodus spp.	8		554	79	32	664	132	484	188	2141
Panderodus bergstroemi			2							2
Panderodus breviusculus										0
Panderodus feulneri										0
Panderodus gibber						27		9		36
Panderodus gracilis										0
Panderodus serratus?										0
Parabelodina denticulata										0
Paroistodus? sp. A			3			1		3	1	8
Periodon aff. *grandis*			35			14	1652	15	8	1724
Phosphannulus universalis	1					3		8	1	13
Phragmodus undatus s.l.			10			23	1461	112	15	1621
Plectodina aculeata										0
Plectodina tenuis		1	16	3		52		2	2	76
Plectodina sp.										0
Plegagnathus nelsoni										0
Polyplacognathus ramosus										0
Prioniodus sp.										0
Protopanderodus liripipus			5	2			17			24
Pseudobelodina adentata?								2		2
Pseudobelodina? dispansa			2	1		1	1	4		9
Pseudobelodina inclinata										0
Pseudobelodina quadrata			2							2
Pseudobelodina v. vulgaris										0
Pseudobelodina aff. vulgaris										0
Pseudooneotodus aff. beckmanni			1							1
Pseudooneotodus mitratus							1			1
Pseudooneotodus sp.					1					1
Pteracontiodus sp. A										0
Ptiloncodus harrisi										0
Strachanognathus parvus										0
Staufferella lindstroemi			2		12			1		15
Staufferella n. sp. A										0
Taoqupognathus philipi										0
Ulrichodina? sp.										0
Walliserodus amplissimus			7		3		2			12
Yaoxiangognathus? tunguskaensis			3				92			95
Zanklodus sp.										0
indet. oistodiform element										0
indet. hook with base										0
indet. serrated sym. element										0
indet. cordylodiform element										0
indet. eobelodiniform element										0
TOTALS	12	8	769	97	37	927	3782	757	270	6659

Table 1g

S16 GSC locality number	O-104479	O-104489	O-104490	O-104494	O-104495	O-104496	Totals
Formation	**FR**	**FR**	**FR**	**FR**	**FR**	**FR**	
Mass (grams)	5885	5805	1185	6125	5335	6075	30410
Percent dissolved	100	99	81	100	100	100	97
Section number	S16	S16	S16	S16	S16	S16	
Species/collection level (m)	0.20	2.45	2.55	6.45	11.50	18.00	
ambalodiform element							0
Amorphognathus tvaerensis?							0
Amorphognathus duftonus							0
Amorphognathus ordovicicus							0
Amorphognathus superbus							0
Ansella nevadensis			5			9	14
Aphelognathus politus							0
Appalachignathus delicatulus	1	2		4	6	8	21
Belodina arca							0
Belodina aff. *arca*							0
Belodina boltoni n. sp.	1					3	4
Belodina confluens			1	6	1	14	22
Belodina lillianae n. sp.							0
Belodina stonei							0
Belodina n. sp. Y							0
Belodina? n. sp. B							0
Belodina? n. sp. X							0
Besselodus borealis							0
Coelocerodontus trigonius							0
Culumbodina occidentalis							0
Culumbodina penna							0
Culumbodina n. sp. X							0
Drepanoistodus suberectus	4			6	4	21	35
Milaculum ethinclarki							0
Milaculum sp. A			1	6	1	1	9
Milaculum sp. B							0
Milaculum sp. C				1			1
Milaculum sp. D							0
N. Gen. A n. sp. A *sensu* McCracken							0
Oulodus rohneri							0
Oulodus velicuspis							0
Oulodus? sp.						0	
Panderodus spp.	38	20	19	96	22	91	286
Panderodus bergstroemi							0
Panderodus breviusculus							0
Panderodus feulneri							0
Panderodus gibber							0
Panderodus gracilis							0
Panderodus serratus?							0
Parabelodina denticulata	1			1			2
Paroistodus? sp. A	2			2	2	12	18
Periodon aff. *grandis*							0
Phosphannulus universalis							0
Phragmodus undatus s.l.				2	1	1	4
Plectodina aculeata							0
Plectodina tenuis							0

Table 1g (cont.)

S16 GSC locality number	O-104479	O-104489	O-104490	O-104494	O-104495	O-104498	Totals
Formation	**FR**	**FR**	**FR**	**FR**	**FR**	**FR**	
Plectodina sp.						0	
Plegagnathus nelsoni							0
Polyplacognathus ramosus	2			1		2	5
Prioniodus sp.							0
Protopanderodus liripipus							0
Pseudobelodina adentata?	1			2	1	3	7
Pseudobelodina? *dispansa*		1				2	3
Pseudobelodina inclinata							0
Pseudobelodina quadrata							0
Pseudobelodina v. vulgaris							0
Pseudobelodina aff. vulgaris				4		1	5
Pseudooneotodus aff. beckmanni				1			1
Pseudooneotodus mitratus							0
Pseudooneotodus sp.							0
Pteracontiodus sp. A			2				2
Ptiloncodus harrisi				1			1
Strachanognathus parvus							0
Staufferella lindstroemi							0
Staufferella n. sp. A							0
Taoqupognathus philipi	1						1
Ulrichodina? sp.							0
Walliserodus amplissimus	4			9	1	15	29
Yaoxiangognathus? *tunguskaensis*							0
Zanklodus sp.							0
indet. oistodiform element	1	1				2	4
indet. hook with base	1				1	2	4
indet. serrated sym. element							0
indet. cordylodiform element						1	1
indet. eobelodiniform element							0
TOTALS	57	24	28	142	40	188	479

Table 1h

S17 GSC locality number	O-104471	O-104472	O-104473	O-104475	O-104476	O-104477	Totals
Formation	**AM**	**AM**	**AM**	**AM**	**AM**	**AM**	
Mass (grams)	6615	6015	1645	5940	6575	6635	33425
Percent dissolved	100	100	96	100	100	100	99
Section number	S17	S17	S17	S17	S17	S17	
Species/collection level (m)	25.40	31.00	32.00	36.90	40.40	44.00	
ambalodiform element							0
Amorphognathus tvaerensis?							0
Amorphognathus duftonus							0
Amorphognathus superbus							0
Amorphognathus ordovicicus			1				1
Ansella nevadensis							0
Aphelognathus politus							0

Table 1h (cont.)

S17 GSC locality number	O-104471	O-104472	O-104473	O-104475	O-104476	O-104477	Totals
Formation	AM	AM	AM	AM	AM	AM	
Appalachignathus delicatulus							0
Belodina arca				1			1
Belodina aff. *arca*							0
Belodina boltoni n. sp.							0
Belodina confluens	1	1	4		2	3	11
Belodina lillianae n. sp.				2			2
Belodina stonei							0
Belodina n. sp. Y							0
Belodina? n. sp. B							0
Belodina? n. sp. X							0
Besselodus borealis							0
Coelocerodontus trigonius						0	
Culumbodina occidentalis							0
Culumbodina penna							0
Culumbodina n. sp. X							0
Drepanoistodus suberectus	2	5	1	4	6		18
Milaculum ethinclarki							0
Milaculum sp. A							0
Milaculum sp. B							0
Milaculum sp. C							0
Milaculum sp. D							0
N. Gen. A n. sp. A *sensu* McCracken							0
Oulodus rohneri							0
Oulodus velicuspis				1			1
Oulodus? sp.							0
Panderodus spp.	22	36	23	43	65	107	296
Panderodus bergstroemi							0
Panderodus breviusculus							0
Panderodus feulneri							0
Panderodus gibber							0
Panderodus gracilis							0
Panderodus serratus?							0
Parabelodina denticulata							0
Paroistodus? sp. A							0
Periodon aff. *grandis*					2	4	6
Phosphannulus universalis		2					2
Phragmodus undatus s.l.							0
Plectodina aculeata		2		1			3
Plectodina tenuis		2		1	4		7
Plectodina sp.						4	4
Plegagnathus nelsoni							0
Polyplacognathus ramosus							0
Prioniodus sp.							0
Protopanderodus liripipus				1		1	2
Pseudobelodina adentata?							0
Pseudobelodina? *dispansa*			1		1	2	
Pseudobelodina inclinata							0

Table 1h (cont.)

S17 GSC locality number	O-104471	O-104472	O-104473	O-104475	O-104476	O-104477	Totals
Formation	AM	AM	AM	AM	AM	AM	
Pseudobelodina quadrata							0
Pseudobelodina v. vulgaris							0
Pseudobelodina aff. vulgaris							0
Pseudooneotodus aff. beckmanni							0
Pseudooneotodus mitratus							0
Pseudooneotodus sp.							0
Pteracontiodus sp. A							0
Ptiloncodus harrisi							0
Strachanognathus parvus							0
Staufferella lindstroemi							0
Staufferella n. sp. A							0
Taoqupognathus philipi							0
Ulrichodina? sp.							0
Walliserodus amplissimus					1	2	3
Yaoxiangognathus? tunguskaensis							0
Zanklodus sp.							0
indet. oistodiform element							0
indet. hook with base							0
indet. serrated sym. element						0	
indet. cordylodiform element							0
indet. eobelodiniform element							0
TOTALS	25	48	29	55	80	122	359

Sanford and Grant in this volume as being conformable with the Amadjuak Formation (below) and the overlying Akpatok Formation, it is not exposed in the studied sections on Baffin Island. The discussion below uses the same section numbers as those of Sanford and Grant and other papers in this volume. Conodont distribution by formation is shown in Table 2.

A number of conodont species were found throughout all four exposed formations. These are:

Table 2

Summary of species distribution, southern Baffin Island

Species	Formation				Total
	Forbisher Bay	Amadjuak	Akpatok	Foster Bay	
Coelocerodontus trigonius	1	236	161	339	737
Drepanoistodus suberectus	148	1797	624	514	3083
Panderodus spp.	867	11025	5032	3818	20742
Paroistodus? sp. A	53	2004	326	1431	3814
Phosphannulus universalis	1	93	24	25	143
Pseudobelodina? dispansa	10	314	112	242	678
Pseudooneotodus aff. *beckmanni*	1	28	36	19	84
Walliserodus amplissimus	85	508	84	207	884
ambalodiform element	2	0	0	0	2
Amorphognathus tvaerensis?	2	0	0	0	2
Ansella nevadensis	53	0	0	0	53
Appalachignathus delicatulus	81	0	0	0	81
Belodina boltoni n. sp.	31	0	0	0	31
Milaculum sp. C	1	0	0	0	1

Table 2 (cont.)

Summary of species distribution, southern Baffin Island

Species	Formation				Total
	Forbisher Bay	Amadjuak	Akpatok	Foster Bay	
Parabelodina denticulata	2	0	0	0	2
Polyplacognathus ramosus	86	0	0	0	86
Pteracontiodus sp. A	42	0	0	0	42
Ptiloncodus harrisi	21	0	0	0	21
indet. hook with base	18	0	0	0	18
Belodina confluens	76	1348	0	0	1424
Milaculum sp. A	28	7	0	0	35
Milaculum sp. B	1	1	0	0	2
Periodon aff. *grandis*	8	7789	0	0	7797
Phragmodus undatus s.l.	7	4614	0	0	4621
Pseudobelodina adentata?	16	5	0	0	21
Pseudobelodina aff. *vulgaris*	14	3	0	0	17
Taoqupognathus philipi	1	1	0	0	2
Amorphognathus superbus	0	28	0	0	28
Aphelognathus politus	0	1	0	0	1
Belodina aff. *arca*	0	3	0	0	3
Belodina n. sp. Y	0	1	0	0	1
Belodina? n. sp. X	0	1	0	0	1
Belodina? n. sp. B	0	3	0	0	3
Culumbodina occidentalis	0	1	0	0	1
Culumbodina n. sp. X	0	3	0	0	3
Milaculum sp. D	0	359	0	0	359
Oulodus velicuspis	0	19	0	0	19
Plectodina aculeata	0	14	0	0	14
Plectodina tenuis	0	271	0	0	271
Plectodina sp.	0	7	0	0	7
Pseudobelodina quadrata	0	5	0	0	5
Staufferella lindstroemi	0	82	0	0	82
Strachanognathus parvus	0	1	0	0	1
Yaoxiangognathus? *tunguskaensis*	0	175	0	0	175
Belodina arca	0	99	1	0	100
Culumbodina penna	0	6	1	0	7
Protopanderodus liripipus	0	238	1	0	239
Belodina lillianae n. sp.	0	60	76	19	155
Besselodus borealis	0	775	57	175	1007
Milaculum ethinclarki	0	78	26	1	105
Plegagnathus nelsoni	0	7	147	111	265
Pseudooneotodus mitratus	0	8	47	31	86
Pseudooneotodus sp.	0	8	22	7	37
Oulodus rohneri	0	0	47	0	47
Pseudobelodina inclinata	0	0	2	0	2
Amorphognathus duftonus	0	0	17	2	19
Amorphognathus ordovicicus	0	0	1042	1297	2339
Belodina stonei	0	0	318	152	470
N. Gen. A n. sp. A *sensu* McCracken	0	0	2	2	4
Pseudobelodina v. vulgaris	0	0	56	67	123
Staufferella n. sp. A	0	0	4	6	10
Oulodus? sp.	0	5	5	3	13
Panderodus bergstroemi	0	24	0	0	24
Panderodus breviusculus	0	1	3	0	4

Table 2 (cont.)

Summary of species distribution, southern Baffin Island

Species	Formation				Total
	Forbisher Bay	Amadjuak	Akpatok	Foster Bay	
Panderodus feulneri	0	11	0	0	11
Panderodus gibber	0	164	68	50	282
Panderodus gracilis	0	0	0	0	0
Panderodus serratus?	1	181	0	0	182
Prioniodus sp.	1	0	0	0	1
Ulrichodina? sp.	1	0	0	0	1
Zanklodus sp.	0	0	63	1	64
indet. oistodiform element	8	7	0	0	15
indet. serrated sym element	0	0	0	0	0
indet. cordylodiform element	1	0	0	0	1
indet. eobelodiniform element	1	0	0	0	1
TOTALS	503	16414	2005	1924	20846

Coelocerodontus trigonius
Drepanoistodus suberectus
Panderodus spp.
Paroistodus? sp. A
Pseudobelodina? *dispansa*
Pseudooneotodus aff. *beckmanni*

Of the listed species, only *Coelocerodontus trigonius* can be considered characteristic of a particular stratigraphic interval. It is extremely rare (only one element) in the Middle Ordovician Frobisher Bay Formation, but very common (736 elements) in the higher, Upper Ordovician strata. Most of the *Panderodus* species are of limited value, and because of their great number they were not all differentiated, most being counted as *Panderodus* spp. Species recognized (over 21,000 elements) include *Panderodus breviusculus* Barnes, *P. feulneri* (Glenister), *P. gibber* Nowlan and Barnes, *P. gracilis* (Branson and Mehl), and the rare *P. serratus* Rexroad. The phosphatic problematica, *Phosphannulus universalis*, also occurs through all four exposed formations.

Frobisher Bay Formation

The Frobisher Bay Formation is about 15 m thick and comprises grey and light brown microcrystalline limestone and dolomitic limestone that weather light grey with minor yellowish-orange mottling. The beds are relatively uniform and hard, massive, and resistant to erosion (Sanford and Grant, this volume).

Conodont species restricted to the Frobisher Bay Formation are:

Amorphognathus tvaerensis?
Ansella nevadensis
Appalachignathus delicatulus
Belodina boltoni n. sp.
Parabelodina denticulata
Polyplacognathus ramosus
Pteracontiodus sp. A

The phosphatic problematica, *Milaculum* sp. C (only one element), *Ptiloncodus harrisi*, and what is termed Indeterminate hook with base are also restricted to the Frobisher Bay Formation.

Species that occur in the Frobisher Bay Formation and that have their upper limit in the Amadjuak Formation are:

Belodina confluens
Milaculum sp. A (incerta sedis)
Milaculum sp. B (incerta sedis)
Periodon aff. *grandis*
Phragmodus undatus s.l.
Pseudobelodina adentata?
Pseudobelodina aff. *vulgaris*
Taoqupognathus phillipi

The unconformable contact between the Frobisher Bay Formation and the Precambrian was found at three sections (S3, S9, S16). At Section 3 (GSC loc. O-104213 on Hone River), important species in the lowest sample, 30 cm above the Precambrian contact, include *Ansella nevadensis*, *Appalachignathus delicatulus*, *Belodina confluens*, and *Pseudobelodina adentata*? *Polyplacognathus ramosus* occurs in the highest sample at this section. The first sample, 2 m above the unconformity, at Section 9 (GSC loc. O-104226, also on Hone River) includes these five species, among others. South of Sylvia Grinnell Lake, at Section 16 (GSC loc. O-104479), the first sample was taken about 0.7 m above Precambrian rock. The species *Appalachignathus delicatulus*, *Polyplacognathus ramosus*, and *Pseudobelodina adentata*? occur in this lowest sample.

Figure 3. *Ranges of selected species in strata of southern Baffin Island.*

Ansella nevadensis and *Belodina confluens* are found higher in the section. Thus within the first 2 to 3 m above the Precambrian, a suite of six diagnostic species occurs: *Ansella nevadensis*, *Appalachignathus delicatulus*, *Belodina confluens*, *Polyplacognathus ramosus*, and *Pseudobelodina adentata*?

There are discrepancies in the known ranges of most of these five species. According to Sweet (1984), the ranges of *Appalachignathus delicatulus* and *Polyplacognathus ramosus* do not overlap. The former has a range from upper Whiterockian to the lower part of the upper Blackriveran; the latter from Rocklandian to within the late Shermanian part of the *Belodina confluens* Zone. However, Barnes (1977) found them both in (but not together) in the Bad Cache Rapids Formation on Melville Peninsula. These occurrences were rare; his *Appalachignathus* sp. was represented by one element, *P. ramosus* by two. He (1977, p. 100) also reported *A. delicatulus* and *P. ramosus* from a sample on Somerset Island. Furthermore, Nowlan (1976) found *P. ramosus* within his *A. delicatulus* Zone in basal Thumb Mountain Formation on Ellesmere Island. More significantly, one element of *P. ramosus* was also reported from within the top of his *Appalachignathus delicatulus* Zone in lower Thumb Mountain strata at Svarte Fiord on Ellesmere Island (Nowlan, 1976, p. 75). It is my conclusion, that in the Canadian Arctic at least, the ranges of *A. delicatulus* and *P. ramosus* overlap.

Belodina confluens is the name bearer of the *Belodina confluens* Zone, the base of which is in the uppermost part of the *Amorphognathus tvaerensis* Zone, and this level corresponds to the mid-Shermanian Substage (Sweet, 1984). This lower limit is higher than the upper limit of *A. delicatulus* but is within the upper range of *Polyplacognathus ramosus* (Sweet, 1984).

The range of *Ansella nevadensis* and *Appalachignathus delicatulus* overlap (cf. Sweet, 1984; Bauer, 1994), but the upper limit of *Ansella nevadensis* is higher compared to that of *A. delicatulus* (upper Blackriveran vs. lower part of the upper Blackriveran; Sweet, 1984). The upper limit of *Ansella nevadensis* is below the first occurrence of *Polyplacognathus ramosus* in the Rocklandian of the midcontinent (Sweet, 1984).

Sweet (1979a) questionably assigned *Eobelodina* sp. s.f. from the Bad Cache Rapids Formation of Melville Peninsula (Barnes, 1977) to *Pseudobelodina adentata*, because the only other known occurrence of the species he described from mid-Maysvillian and younger strata of western United States (Colorado and Wyoming). Thus the range of *P. adentata* sensu stricto is also at odds with some of the other conodonts in the Frobisher Bay Formation, but this is not surprising given the limited knowledge of its distribution.

If the identifications are correct, then the ranges of at least some of these five species are greater in provinces outside that of the North American midcontinent.

Concerning the other species listed as being found only within the Frobisher Bay Formation, two are rare: *Milaculum* sp. C (incerta sedis) and *Parabelodina denticulata*, and the full extent of their ranges is not known. The latter was defined on Late Ordovician material from the Lower Big Horn Group in Wyoming and Fremont Formation in Colorado (Sweet, 1979a). The identification of *Amorphognathus tvaerensis*? is tentative because the diagnostic M element was not found. The species is questionably identified because of stratigraphic position, below strata containing *Amorphognathus superbus*. *Belodina boltoni* n. sp. is like *Belodina*? sp. (and *Belodina* sp.), illustrated from the late Early and early Middle Ordovician (Mountain Lake Member, Bromide Formation) in Oklahoma (respectively, Bauer, 1990 and Bauer, 1994). *Ptiloncodus harrisi* was originally recorded from the Trentonian Viola Limestone of Oklahoma, and is thus younger than *Ptiloncodus simplex*, which was first reported from the Chazyan Joins Formation of Oklahoma. The former has also appeared in even younger strata (Richmondian) on Anticosti Island (McCracken and Barnes, 1981).

Of the other species that range into higher strata, *Milaculum* sp. A, *Milaculum* sp. B, and *Pseudobelodina* aff. *vulgaris* are not useful biostratigraphically since they are local forms. *Pseudobelodina* aff. *vulgaris* was not found in the higher Akpatok Formation on Baffin Island, but is recognized in unpublished material from this formation on Akpatok Island. *Periodon* aff. *grandis* is similar to *P. grandis*, which has a range in Sweet's (1984) composite standard section from the base of the *P. undatus* Zone (Rocklandian) and upward. *Taoqupognathus philipi* was identified by Savage (1990) from the Caradoc Gleesons Limestone and Wyoming Limestone members (Fossil Hill Limestone) in southeastern Australia. It was first reported from the *Belodina confluens* Zone, middle to upper Caradoc (mid-Shermanian – mid-Edenian) strata of southeastern Australia (Savage, 1990), but Zhen and Webby (1995, p. 276) argued for a slightly older age for these collections, suggesting correlation with the "upper *P. undatus* Zone, or a Rocklandian–Kirkfieldian–early Shermanian age". The species is very rare in the Baffin collections; one element occurs in the Frobisher Bay Formation, and one in the succeeding Amadjuak Formation.

Bolton (this volume) recognized four distinct megafossil assemblages that previously were united in the tropical "Arctic Ordovician Red River fauna". The megafauna of the Frobisher Bay Formation is a distinctive *Gonioceras–Labyrinthites*–sponge suite indicative of a Middle Ordovician Blackriveran to Rocklandian age. Given the range discrepancies of the conodonts, any attempt at further refinement of this age range is tentative. However, *Polyplacognathus ramosus* suggests the younger age.

Amadjuak Formation

The Upper Ordovician Amadjuak Formation is well exposed on southern Baffin Island. Small outliers occur south of Sylvia Grinnell Lake and larger ones toward Frobisher Bay at Jordan River and the famous Silliman's Fossil Mount, which was studied earlier in this century (McCracken, this volume). Silliman's Fossil Mount is the type section for the formation where parts of the three units are exposed. The strata of the lower unit 1 (20–28 m thick) are uniform to nodular bedded light grey to dark brown argillaceous limestone interbedded with medium to dark grey shale. At the Jordan River outlier and on Amadjuak Lake, the base contains black bituminous shale (oil shale) bearing trilobites and graptolites. The middle unit 2 (20–40 m) comprises nodular to flaggy and rubbly weathering, thin bedded, argillaceous limestone with minor shale interbeds. The upper unit 3 (28–35 m) is found in part at Silliman's Fossil Mount, and also in the Putnam Highlands where it comprises massive, resistant, light to medium brown, nodular bedded limestone and dolomitic limestone that form an abrupt and conspicuous escarpment. All of these rocks, especially those of the upper two units, weather to a characteristic mottled grey and yellowish orange colour (Sanford and Grant, this volume).

A major change in the conodont faunas from the Frobisher Bay Formation to the Amadjuak Formation reflects the Middle Ordovician unconformity. As discussed before, a number of species range throughout all formations, and another eight are restricted to both the Frobisher Bay and Amadjuak formations. Species restricted to the Amadjuak Formation are:

Amorphognathus superbus
Aphelognathus politus
Belodina aff. *arca*
Belodina? n. sp. B
Culumbodina occidentalis
Culumbodina n. sp. X
Milaculum sp. D (incerta sedis)
Oulodus velicuspis
Plectodina aculeata
Plectodina tenuis s.l.
Pseudobelodina quadrata
Staufferella lindstroemi
Strachanognathus parvus
Yaoxianognathus? *tunguskaensis*

Species that have their first appearance in the Amadjuak Formation, but continue into the Akpatok Formation are:

Belodina arca
Belodina lillianae n. sp.
Besselodus borealis
Culumbodina penna

Milaculum ethinclarki (incerta sedis)
Plegagnathus nelsoni
Protopanderodus liripipus
Pseudooneotodus mitratus
Pseudooneotodus sp.

The lower part of the Amadjuak Formation at the Jordan River outlier (Section 11A) contains "oil shale" interbeds with *Pseudogygites* and *Triarthrus* trilobites and graptolites. Riva (this volume) reports latest Mohawkian–early Edenian graptolites (lower *Climacograptus spiniferous* Zone) from these "oil shales". In support of an early Edenian age for an upper limit, Asselin et al. (this volume), assign the chitinozoan microfauna from the same beds to the *Acanthochitina cancellata* Zone (Shermanian–Edenian transition). Bergström and Mitchell (1994) correlated the *C. spiniferous* Zone to an interval within the *B. confluens* Zone. Black beds on Amadjuak Lake (Section 14; GSC loc. O-104248) bearing *Pseudogygites* trilobites and thin shelled brachiopods are probably equivalent and contain the upper Shermanian–lower Maysvillian *Amorphognathus superbus*. These beds are more or less the same ones collected by McMillan and Macauley in 1986 and reported in McCracken and Nowlan (1989; GSC loc. C-151098, C-151099).

Strata of sections 11 and 11A on Jordan River, and at the Jordan River outlier, respectively, include both the Frobisher Bay and Amadjuak formations, although the contact was not recorded. The first sample (GSC loc. O-104536) of the Amadjuak Formation at this composite section is about 1.5 m below the graptolite beds and is distinguished by *Belodina* aff. *arca*, *Besselodus borealis*, *Coelocerodontus trigonius*, *Plectodina tenuis* s.l., *Protopanderodus liripipus*, and *Yaoxianognathus*? *tunguskaensis*. None of these are particularly useful in confirming the age that was based on graptolites and chitinozoans. The last four conodont species are found in older strata elsewhere. This sample also contains an undiagnostic element questionably assigned to *Amorphognathus superbus*. The few elements of *Belodina* aff. *arca* differ from *Belodina arca* (see Systematic Taxonomy), although the lower number of denticles might not justify segregating them as a related species. *Belodina arca* sensu stricto has a range of mid-Edenian to mid-Maysvillian, approximately the *Oulodus velicuspis* Zone (Sweet, 1979a, 1984). At Silliman's Fossil Mount (S10), *Belodina arca* is found in abundance in units 1–2 and into unit 3 (e.g., GSC loc. O-104510, O-104522).

In higher strata, the Amadjuak Formation contains a distinctive coral, nautiloid, and trilobite assemblage that represents another part of the Arctic Ordovician Red River fauna. This assemblage has an early Late Ordovician, Edenian–early Maysvillian age (Bolton, this volume). The *Oulodus velicuspis* Zone is recognized in the Amadjuak Formation at two localities (S10, S17). At Silliman's Fossil Mount (S10; GSC loc. O-104510) it first occurs about 2.6 m above the base of the section, and at a level about 29 m higher (GSC loc. O-104521), that is, through units 1 and 2. This zonal species has a range of mid-Edenian to mid-Maysvillian (Sweet, 1984). At S17, its occurrence is at 32 m above the base of the section.

On the Hone River, the Amadjuak Formation at Section 1 was sampled at two levels, thus spanning the boundary between units 2 and 3 (Sanford and Grant, this volume). The fauna of the lower sample (GSC loc. O-104209) is limited. The one element of *Plectodina tenuis* indicates only the *P. tenuis* Zone (uppermost Kirkfieldian or younger). However, one element of *Culumbodina occidentalis* also occurs and this has a range of mid-Edenian to mid-Maysvillian (*O. velicuspis* Zone), thus this part of unit 2 is no older than mid-Edenian. The higher sample (GSC loc. O-104210) is also limited. A few elements of *Amorphognathus* are present, but the species cannot be identified with certainty (presumably *A. superbus*). The only diagnostic species in this sample of unit 3 is *Plegagnathus nelsoni*. Sweet (1979a) distinguished between two species of *Plegagnathus*; *P. nelsoni* has a range of uppermost Edenian–Richmondian (*Oulodus velicuspis* Zone and higher), while *P. dartoni* was restricted to the Richmondian. I cannot differentiate between this pair of species based on the Baffin material, but at least part of the Amadjuak Formation must be late Edenian or younger based on the range of *P. nelsoni*. Elsewhere on Baffin Island (e.g., Section 2), the fauna of unit 3 is no more diagnostic, containing *Belodina arca*, *B. confluens*, and *Plectodina tenuis*.

Belodina lillianae n. sp. has been equated with *Belodina* aff. *stonei* from the Richmondian Sixteen Mile Brook oil shale locality on Southampton Island (McCracken and Nowlan, 1989). I now recognize this as a distinct species from other co-occurring species – *Belodina stonei*, *B. arca*, and *B. confluens*. On Baffin, this new species occurs in the Amadjuak Formation, and higher strata, including the known part of the lower Foster Bay Formation (Richmondian, see below).

Yaoxianognathus? *tunguskaensis* has been found in mid-Shermanian to mid-upper Edenian strata of southeastern Australia (Trotter and Webby, 1994; Zhen and Webby, 1995). Zhen and Webby (1995) assigned the Fossil Hill Formation of the Cliefden Caves Limestone Group to the upper *Phragmodus undatus* Zone (Rocklandian–early Shermanian), and the upper two formations of the group to Shermanian (in part, *Plectodina tenuis–B. confluens* zonal interval). The disconformably succeeding strata, the Malongulli Formation, also contained rare *Yaoxianognathus*? *tunguskaensis*. Trotter and Webby (1994, p. 479) regarded these rocks as representing the lower part of the *O. velicuspis* Zone ("middle to upper Edenian Stage").

Concerning taxa in the Amadjuak Formation that have limited biostratigraphic value: *Besselodus* is not well known, having previously been found in the Ashgill of Greenland (*Besselodus arcticus* Aldridge, 1982), Richmondian of western Canada (*Besselodus borealis* Nowlan and McCracken *in* Nowlan et al., 1988), and Middle Ordovician (Shermanian) of Australia (*Besselodus* sp. Zhen and Webby, 1995); *Milaculum ethinclarki* was originally described from the Middle Ordovician Kirkfield Formation of Ontario, but an Early Ordovician form is called *Milaculum* aff. *M. ethinclarki* by Ethington and Clarke (1981), and a Late Ordovician form (Nowlan et al., 1988) is *Milaculum* aff. *M. ethinclarki*; and *Strachanognathus parvus* ranges from Arenig (Löfgren, 1978, p. 112) through the Ashgill (McCracken, 1987).

The base of unit 1 of the Amadjuak Formation is latest Mohawkian–early Edenian, unit 2 is mid-Edenian or younger, and the lower part of unit 3 is latest Edenian.

Akpatok Formation

The Akpatok Formation is based on the succession of rocks on Akpatok Island in Ungava Bay (Sanford and Grant, 1990). It comprises over 240 m, but on Baffin Island, only about 9 m of the uppermost part are exposed west of Amadjuak Lake (Section 8). Here it comprises light grey argillaceous limestone in resistant nodular beds that weather medium to dark grey. It is conformably overlain by the Foster Bay Formation. Sanford and Grant (this volume) state that the formation conformably overlies the Boas River Formation, but on Baffin Island, the base and much of the lower part of the Akpatok Formation are not exposed.

As discussed previously, a number of species range throughout all formations, and another nine are found in the Amadjuak and higher strata. Of the latter group, *Belodina arca*, *Culumbodina penna*, and *Protopanderodus liripipus* have their upper limits in the Akpatok Formation. Species that have their first appearances in the Akpatok Formation, and range upward into the Foster Bay are:

Amorphognathus duftonus
Amorphognathus ordovicicus
Belodina stonei
N. gen. A n. sp. A sensu McCracken
Pseudobelodina v. vulgaris
Staufferella n. sp. A

On Baffin Island, only two species, *Oulodus rohneri* and *Pseudobelodina inclinata* (latter is Edenian and younger) are restricted to the Akpatok Formation, and none is unique to the Foster Bay Formation.

In the more complete section on Akpatok Island, unpublished data on a fauna of a sample 10 m above the base of the section (GSC loc. O-104662) in basal Akpatok Formation include *Culumbodina occidentalis*, *Decoriconus* sp., *Plectodina florida*, and *Pseudobelodina quadrata*. Ten metres higher (GSC loc. O-104664) are *Belodina arca*, *Culumbodina penna*, and *Pseudobelodina* aff. *vulgaris*, all of which occur in Amadjuak strata on Baffin Island. *Culumbodina occidentalis* is restricted to the *Oulodus velicuspis* Zone (mid-Edenian to mid-Maysvillian). *Plectodina florida*, which is not positively identified in the Akpatok Formation on Baffin Island, ranges from mid-Edenian into the Richmondian according to Sweet (1984). *Pseudobelodina quadrata* has a range of mid-Edenian–Richmondian, and was a rare component of the Amadjuak Formation on Baffin Island. *Decoriconus* is known from few localities, and ranges from Late Ordovician to Early Silurian. Besides lacking *Plegagnathus*, the collections from Akpatok Island are notable in their absence of *Amorphognathus* species (or fragments). Thus the lower part of the formation could be as old as mid-Edenian, but likely is younger because of a latest Edenian age estimate for the upper part of the Amadjuak Formation.

The transition from Akpatok to Foster Bay formations is found at Section 8 west of Amadjuak Lake. Here, *Amorphognathus ordovicicus*, which has a range of early to mid-Maysvillian and younger, and *Pseudobelodina v. vulgaris* were identified in the uppermost beds of the Akpatok and the overlying Foster Bay formations. *Pseudobelodina v. vulgaris* has a range of mid-Edenian–Richmondian (Sweet, 1984). *Plegagnathus nelsoni* is common in both formations at this section. As mentioned previously, this species has a range of uppermost Edenian–Richmondian (*Oulodus velicuspis* Zone and higher). Unfortunately, the genus is absent from the more complete 105 m surface section on Akpatok Island.

On Baffin Island, the highest occurrences of *Culumbodina penna*, *Milaculum ethinclarki* (which is not age diagnostic) and *Oulodus rohneri* are in the Akpatok Formation, near the base of the Foster Bay Formation at Section 8 west of Amadjuak Lake. *Culumbodina penna*, which is found about 2 m below the base of the Foster Bay (GSC loc. O-104500), has a range of mid-Edenian to mid-Maysvillian. However, one metre higher is the first (and only) occurrence of a number of elements of *Oulodus rohneri* (GSC loc. O-104502). This is a Richmondian species, which ranges elsewhere into the Gamachian (*Aphelognathus divergens* Zone or younger). *Belodina stonei* co-occurs with *O. rohneri*, and is also found about a metre higher in the highest sampled bed of the Akpatok Formation (GSC loc. O-104223). This species is thought to be restricted to the Richmondian (Sweet, 1979a).

The ramiform component of the faunas above and below this contact is dominated by *Amorphognathus ordovicicus*, representing the zone of the same name, which has a lower range limit within the lower half of the Maysvillian. A rare (4 elements in total) and unusal form called N. Gen. A n. sp. A by McCracken (1987) is present in both the Akpatok (GSC loc. O-104502, O-104223) and Foster Bay (GSC loc. O-104225) formations. McCracken found a few of these elements in the Late Ordovician in northern Yukon and Arctic Islands (see Systematic Taxonomy).

The megafauna lacks diagnostic fossils, but Bolton (this volume) believed that the formation is late Maysvillian–Richmondian, and most likely the latter. The highest beds of the Akpatok Formation on Baffin Island are at least Richmondian based on *Oulodus rohneri* and *Belodina stonei*.

Foster Bay Formation

The Foster Bay Formation is defined on strata on Melville Peninsula in western Foxe Basin (Sanford and Grant, this volume) and conformably succeeds the Akpatok Formation. In the Evans Strait, it may be over 100 m thick, but on Baffin Island, its preserved thickness is much less (Sanford and Grant, this volume). On Baffin Island, it is found only at the section described above for the Akpatok Formation. At this section (S8), west of Amadjuak Lake, it comprises about a metre of bituminous, medium brown dolomitic limestone in thin, platy, laminated beds (Sanford and Grant, this volume). The conodont fauna does not have any species that distinguish the Foster Bay Formation from the underlying Akpatok Formation, and megafossils are absent from the Baffin Island beds. But, by superposition, the Foster Bay Formation is at least Richmondian, since the strata overlie the Richmondian uppermost beds of the Apkatok Formation.

Biostratigraphic summary

The Frobisher Bay Formation, which unconformably overlies Precambrian strata, is regarded as having an age range of Rocklandian to late Shermanian based on the appearance of *Polyplacognathus ramosus*, which is found throughout the formation. The conodont assemblage includes *Ansella nevadensis*, *Appalachignathus delicatulus*, *Belodina confluens*, *Belodina boltoni* n. sp., *Parabelodina denticulata*, *Phragmodus undatus*, *Pteracontiodus* sp. A, and *Taoqupognathus philipi*. The phosphatic microfossil *Ptiloncodus harrisi* is also present. The megafauna is regarded as Blackriveran to Rocklandian, so a concurrent age estimate is Rocklandian based on both micro- and megafossils.

The lowest sample of the Amadjuak Formation contains *Belodina* aff. *arca* and *Yaoxianognathus*? *tunguskaensis*. Graptolites just above this are assigned to the latest Mohawkian–early Edenian graptolites (lower *Climacograptus spiniferous* Zone), which corresponds to an interval within the *Belodina confluens* Zone. In addition, lowest beds contain *Amorphognathus superbus*, which indicates a late Shermanian to early Maysvillian age.

The mid-Edenian to mid-Maysvillian *Oulodus velicuspis* Zone is recognized higher in unit 1 through to unit 3 based on this species and *Belodina arca*. Beds of this formation contain *Culumbodina occidentalis* and *C. penna*, which have a similar range. Conodonts found throughout the formation include *Belodina lillianae* n. sp., *Besselodus borealis*, *Coelocerodontus trigonius*, *Culumbodina* n. sp. X, *Periodon* aff. *grandis*, *Phragmodus undatus*, *Plectodina tenuis*, *Protopanderodus liripipus*, *Pseudobelodina quadrata*, *Pseudooneotodus mitratus*, *Staufferella lindstroemi*, and *Strachanognathus parvus*. The age range estimate for this formation is latest Mohawkian–latest Edenian; *Plegagnathus nelsoni* in unit 3 indicates a late Edenian age or younger.

Conodont faunas from the uppermost Akpatok and lower Foster Bay are similar. Lower Akpatok strata on Akpatok Island, which contain *Belodina arca*, *Culumbodina occidentalis*, *Plectodina florida*, and *Pseudobelodina quadrata*, are assigned to the *Oulodus velicuspis* Zone. Strata at the top of the formation on Baffin Island contain the name-bearer of the *Amorphognathus ordovicicus* Zone (early to mid-Maysvillian–Richmondian). Also present are *Amorphognathus duftonus*, *Belodina arca*, *Belodina lillianae* n. sp., *Besselodus borealis*, *Coelocerodontus trigonius*, *Plegagnathus nelsoni*, *Pseudobelodina v. vulgaris*, *Pseudooneotodus mitratus*, and *Staufferella* n. sp. A. *Oulodus rohneri* and *Belodina stonei* also occur in these beds, and are indicative of the Richmondian (*Aphelognathus divergens* Zone or younger). The age range estimate for this formation is latest Edenian–early Richmondian.

The Foster Bay Formation is Richmondian in age based on stratigraphic position. Its conodont fauna includes *Amorphognathus duftonus*, *A. ordovicicus*, *Belodina lillianae* n. sp., *Belodina stonei*, *Besselodus borealis*, *Coelocerodontus trigonius*, *Plegagnathus nelsoni*, *Pseudobelodina v. vulgaris*, *Pseudooneotodus mitratus*, and *Staufferella* n. sp. A.

CONODONT PROVINCIALISM

The Late Ordovician conodont faunas contain species characteristic of two faunal regions. Conodonts of the Midcontinent Faunal Region include species of *Aphelognathus*, *Belodina*, *Culumbodina*, *Oulodus*,

Phragmodus, *Plectodina*, and *Pseudobelodina*. Species of *Amorphognathus* and *Periodon* represent the Atlantic Faunal Region. A new province within the Midcontinent Faunal Region was recently identified by Nowlan et al. (1997). This is the Australasian Province and is found in Australia, northern China and Canada. It is characterized by the presence of *Taoqupognathus* and *Yaoxianognathus*. Nowlan et al. (1997) identifed Canadian localities of this province in the Selwyn Basin of northwestern Canada. Both occurrences in the Selwyn Basin are Ashgill whereas Australian occurrences are Caradoc. The Baffin Island occurrences of components of this Australasian Province are also older than the Selwyn Basin occurrences.

PALEONTOLOGY

In the Baffin Island collections, conodont colour alteration indices are low. The CAI = 1, although bases are commonly darkened. This same value is seen in conodonts from my collections from Akpatok Island in Ungava Bay, Southampton Island in Hudson Bay, and in the subsurface of the Winisk River area of the Hudson Bay Lowlands. This value indicates little alteration, although it must be noted that all areas are marginal to their respective basins.

The plates are arranged to show ascending stratigraphic order. All illustrated specimens are assigned Geological Survey of Canada type numbers (GSC 116705 to GSC 116837) and are housed in the National Type Collection of Invertebrate and Plant Fossils at the Geological Survey of Canada, 601 Booth Street, Ottawa, Ontario K1A 0E8.

TAXONOMIC REMARKS

A number of species are well known, and require little or no additional comment.

Amorphognathus ordovicicus Branson and Mehl, 1933 (Plate 4, fig. 6–9)

Amorphognathus superbus (Rhodes, 1953) (Plate 2, fig. 1, 2)

Remarks. Although not common, this species is positively recognized on the basis of its holodontiform element. The platform elements are fragmentary.

Amorphognathus tvaerensis Bergström, 1962? (Plate 1, fig. 1)

Remarks. Amorphognathus elements are not common in the Frobisher Bay Formation. Elements characteristic of *A. tvaerensis* were not found; the tentative species identification is a result of biostratigraphic position.

Aphelognathus politus (Hinde, 1879) (Plate 2, fig. 3)

Remarks. Aphelognathus politus is known only by this one element from Section 12 in the Baffin collection. The sample lacks any other element that could be assigned to *Aphelognathus*, or for that matter, to the similar *Oulodus* or *Plectodina*. The relative lengths of processes and amount of arching of the Pb element are similar to the same features in *Aphelognathus packhami* Savage as illustrated by Zhen and Webby (1995, cf. Pl. 1, fig. 2).

Appalachignathus delicatulus Bergström, Carnes, Ethington, Votaw and Wigley, 1974 (Plate 1, fig. 5–7)

Remarks. Nowlan (1976) identified *Appalachignathus delicatulus* in the upper part of the Bay Fiord Formation through to the lower part of the Thumb Mountain Formation in the Canadian Arctic. *Appalachignathus delicatulus* was identified from the Chazy and Blackriveran strata of southwestern Northwest Territories (Tipnis et al., 1978). Smith (1982) also reported the occurrence of *A. delicatulus* from Chazy rocks of east Greenland.

Besselodus borealis Nowlan and McCracken *in* Nowlan et al., 1988 (Plate 4, fig. 12–14)

Remarks. The oistodiform element is the most distinctive element of this genus. The oistodiform element of the Baffin species has a lower anterior-basal corner like that of *Besselodus borealis* rather than like the rounded "V"-shape in the type species, *B. arcticus* Aldridge.

Culumbodina occidentalis Sweet, 1979 (Plate 2, fig. 16)

Remarks. The illustrated element has a proclined cusp and inconspicuous denticles as found on one of the elements in the type series (cf. Sweet's, 1979a, Fig. 6(25) element). Previous reported occurrences of this species from the Arctic include *Belodina* n. sp. B from the Thumb Mountain Formation, Bathurst Island (Barnes, 1974), New Genus A n. sp. 2 and New Genus A n. sp. 3 Barnes (1977) from the Bad Cache Rapids Formation, Melville Peninsula.

Culumbodina penna Sweet, 1979 (Plate 2, fig. 17)

Remarks. Previous reported occurrences of this species from the Arctic include *Belodina* n. sp. A from the Thumb Mountain Formation, Bathurst Island (Barnes, 1974), and Irene Bay Formation (Barnes, 1977), and New Genus A n. sp. 1 Barnes (1977) from the Bad Cache Rapids Formation, Melville Peninsula. Barnes (1977, p. 108) also noted that it occurs in the "thin black shale that lies between the Bad Cache Rapids and the Churchill River groups of Southampton Island, northern Hudson Bay" (i.e., Boas River Formation).

Drepanoistodus suberectus (Branson and Mehl, 1933) (Plate 1, fig. 12; Plate 2, fig. 20, 21)

Oulodus rohneri Ethington and Furnish, 1959 (Plate 4, fig. 20)

Remarks. The illustrated Pb element has the typical compressed denticles and cusp.

Parabelodina denticulata Sweet (Plate 1, fig. 13)

Remarks. The illustrated element has the anterolateral costa as found on all elements except for the similiform rastrate element. Like the falciform element, it has only two denticles. It differs from most elements in that the heel is relatively low and narrow.

Paroistodus? sp. A Nowlan and McCracken *in* Nowlan et al., 1988 (Plate 2, fig. 27)

Phragmodus undatus Branson and Mehl, 1933 (Plate 2, fig. 30, 31; Plate 3, fig. 1, 2)

Phragmodus undatus Branson and Mehl, 1933? (Plate 1, fig. 15, 16)

Remarks. The lowest occurrence of *Phragmodus* is at Jordan River. At this locality (GSC loc. O-104535), a species of *Phragmodus* is recognized by the (oistodiform) M element. *Phragmodus undatus* is not the only species with this form of M element, and since other elements were not found, the identification remains tentative.

Plectodina aculeata (Stauffer, 1930) (Plate 3, fig. 3, 4)

Remarks. This is not a common species in the Amadjuak Formation, and not all of its element morphotypes were found. The distinctive dichognathiform Pa element was not recognized.

Plectodina tenuis inclinata (Glenister, 1957) (Plate 3, fig. 5–8)

Remarks. Elements of the two subspecies of *Plectodina tenuis*, except for the ozarkodiniform and trichonodelliform elements, are indistinguishable. The ozarkodiniform element of *P. t. tenuis* has an anterior process considerably longer than the posterior process, and the trichonodelliform element has a long, denticulated posterior process (Sweet et al., 1975). Both subspecies co-occur on Baffin Island.

Plectodina tenuis tenuis (Branson and Mehl, 1933) (Plate 3, fig. 9)

Remarks. The ozarkodiniform element of *Plectodina tenuis tenuis* has anterior and posterior processes of subequal length, and the trichonodelliform element has a short posterior process that either has only a few short denticles or lacks them altogether (Sweet et al., 1975).

Plegagnathus nelsoni Ethington and Furnish, 1959 (Plate 4, fig. 21–23)

Polyplacognathus ramosus Stauffer, 1935 (Plate 1, fig. 17–19)

Protopanderodus liripipus Kennedy, Barnes and Uyeno, 1979 (Plate 3, fig. 10)

Pseudobelodina? *dispansa* (Glenister, 1957) (Plate 1, fig. 22, 23; Plate 3, fig. 13; Plate 4, fig. 24)

Pseudobelodina inclinata Sweet, 1979 (Pl. 4, fig. 25)

Remarks. The illustrated Sb element is straight, not bowed, and has a smooth face on the furrowed side and a sharp and strong anterolateral costa on the unfurrowed side.

Pseudobelodina quadrata Sweet, 1979 (Plate 3, fig. 14, 15)

Pseudobelodina vulgaris vulgaris Sweet, 1979 (Plate 4, fig. 26, 27)

Pseudobelodina aff. *vulgaris* Sweet, 1979 (Plate 1, fig. 24, 25)

Remarks. This species is like *Pseudobelodina vulgaris* in that it has only two to three denticles; however, the heel is much wider. Both illustrated elements are bowed slightly to the unfurrowed side, so by definition they are S elements.

Pseudooneotodus aff. *beckmanni* (Bischoff and Sannemann, 1958) (Plate 4, fig. 28)

Remarks. Orchard (1980) noted that the type material of *Pseudooneotodus beckmanni* differed from unicuspate and non-serrate elements previously identified as this species.

Pseudooneotodus mitratus Moskalenko (Plate 4, fig. 29)

Remarks. Some of the elements of this species are nodose (see Nowlan and McCracken *in* Nowlan et al., 1988).

Staufferella lindstroemi (Ethington and Schumacher, 1969) (Pl. 3, fig. 16–18)

Remarks. The most distinctive element in *Staufferella* is the Sa element. The posterior face of *S. lindstroemi* has a median costa, whereas the same element in *S. falcata* has a pair of carinae with a groove between.

Strachanognathus parvus Rhodes, 1955 (Plate 3, fig. 19)

Remarks. Dzik (1994) described this species as an extremely conservative conodont species that ranges from Early to Late Ordovician without any significant evolutionary changes. The Baffin elements show the diversity of symmetry and morphology that allowed Dzik (1989, 1994) to identify a six-element apparatus.

Walliserodus amplissimus (Serpagli, 1967) (Plate 1, fig. 29, 30; Plate 3, fig. 20–24)

SYSTEMATIC TAXONOMY

Genus *Amorphognathus* Branson and Mehl, 1933

Amorphognathus duftonus Rhodes

Plate 4, figures 1–5

Amorphognathus duftonus RHODES, 1955, p. 123–124, Pl. 9, fig. 1, 3, 5, 8; BERGSTRÖM and ORCHARD, 1985, Pl. 2.5, fig. 1, 6 [fig. 6 = fig. 28 of Orchard, 1980].
Amorphognathus aff. *A. duftona* Rhodes. ETHINGTON, 1959, p. 270–271, Pl. 40, fig. 11; CHEN and JI, 1986, p. 96, Pl. 1, fig. 18.
Amorphognathus lindstroemi (Serpagli). ORCHARD, 1980, p. 16, Pl. 4, fig. 28 [M; includes synonymy].
Amorphognathus aff. *lindstroemi* (Serpagli). ORCHARD, 1980, p. 16, Pl. 4, fig. 14 [M element].

Types. Hypotypes GSC 116804–116808.

Remarks. The characteristic element of this species is the M element, which has a triangular denticle on one side.

Amorphognathus duftonus is not well known. This is the first illustrated report from the Canadian Arctic. However, it has previously been recognized on Middle Island (in McCormick Inlet by Melville Island), western Canadian Arctic Archipelago (McCracken, 1986, GSC loc. C-134206). This Middle Island sample was initially reported as coming from the Irene Bay Formation, but current interpretation is that it is the Cape Phillips Formation (Harrison, 1995, p. 302), and is associated with a similar, Late Ordovician *A. ordovicicus* Zone fauna.

Material. 17 elements in the Akpatok, 2 in the Foster Bay formations (19 elements total).

Genus *Ansella* Fåhræus and Hunter, 1985

Ansella nevadensis (Ethington and Schumacher)

Plate 1, figures 2–4

Oistodus nevadensis ETHINGTON AND SCHUMACHER, 1969, p. 467–468, Pl. 68, fig. 1–4, Text-fig. 5C.
Ansella nevadensis (ETHINGTON and SCHUMACHER). SHAW, ROBERSON and HARRIS, 1991, Pl. 1, fig. 5–7; McCRACKEN, 1991, p. 47–49, Pl. 3, fig. 3, 4, 8, 9, 13, 14, 19–31 [includes synonymy]; LEHNERT, 1995, p. 71–72, Pl. 6, fig. 1, Pl. 9, fig. 3, Pl. 18, fig. 1–4 [includes synonymy].
non Ansella nevadensis (ETHINGTON & SCHUMACHER). FÅHRÆUS and HUNTER, 1985, p. 1175–1176, Pl. 1, fig. 7, 10, Pl. 2, fig. 11, 13, 14, Fig. 2 [= *Ansella sinuosa* (Stouge, 1984); cf. Lehnert, 1995, p. 72].

Types. Hypotypes GSC 116706–116708.

Remarks. A number of authors have extensively discussed differences in species of *Ansella* (c.f. Löfgren, 1978; Ethington and Clark, 1981; Fåhræus and Hunter, 1985; Watson, 1988; McCracken, 1991; Bauer, 1994). In the present discussion the critical point is the nature of the upper margin on the biconvex element (terminology of Löfgren, 1978). Most species (*Ansella crassa* Bauer, *A. robusta* Ethington and Clark, *A. sinuosa* (Stouge), *A.* sp. nov. Watson, *A. jemtlandica* Löfgren) have a biconvex element that has an adenticulate upper margin, or at the most, this margin is faintly serrated. This same element in *A. nevadensis* has fine but distinct denticles on the upper margin.

In this respect, the species from Baffin Island is therefore identified as *A. nevadensis*. In an unpublished dissertation, Nowlan (1976) assembled a new species of *Belodella* that he found in the middle to upper part of the Bay Fiord Formation and rarely in the basal Thumb Mountain Formation of the Canadian Arctic. He also noted that his new species was present in unpublished (at the time) material from the Ship Point Formation of Melville Peninsula (see *Belodella erecta* (Rhodes and Dineley) s.f. and *Belodella* n. sp. s.f. in Barnes, 1977; both questionably assigned to *Ansella* sp. Nov. Watson, 1988). Under *Belodella* n. sp. s.f., Barnes (1977, p. 101) described elements that are "adenticulate to weakly denticulate". I regard Barnes' (ibid., p. 101, Pl. 2, fig. 6) "weakly denticulate" elements as being not biconvex elements but rather plano-convex elements of *Ansella jemtlandica* (compare with Löfgren, 1978, Pl. 15, fig. 4).

At other northern localities, *Ansella nevadensis* was found in Llanvirn strata (upper *P. tentaculatus* graptolite Zone, *Pygodus serra* Zone) in northern Yukon (McCracken, 1991). Smith (1982) reported (but did not illustrate) it (his *Belodella nevadensis*) from Chazy strata of east Greenland that also contained *Appalachignathus delicatulus* Bergström et al. and *Pygodus* cf. *P. anserinus* (Lamont and Lindström).

Material. 53 elements in the Frobisher Bay Formation (only).

Genus *Belodina* Ethington, 1959

Belodina arca Sweet

Plate 2, figures 4–6

Belodina arca SWEET, 1979a, p. 58–59, Fig. 6(19) [includes synonymy to 1978]; McCRACKEN and NOWLAN, 1989, p. 1896, 1898, Pl. 1, fig. 17, 18.
Belodina compressa (Branson and Mehl). BARNES, 1977 (in part), p. 5, Pl. 4, fig. 16 (only).
Belodina leithi Ethington and Furnish. BARNES, 1977, p. 105, Pl. 4, fig. 20–22.

Types. Hypotypes GSC 116742–116744.

Remarks. Sweet (1979a) thought that the species was trimembrate, with the eobelodiniform elements being indistinguishable from the same element in *Belodina confluens*.

Eobelodiniform elements are rare in the Baffin material, regardless of *Belodina* species. Three forms of eobelodiniform elements are distinguished. The form that has a somewhat straight posterior margin is assigned to *Belodina confluens*. Another form that has a posteriorly extended base is placed within *Belodina lillianae* n. sp., following McCracken and Nowlan (1989). The third form is distinctly bowed compared to the other two laterally compressed forms, and it has a posterior basal margin with a straight to concave lateral profile. Since all three forms occur together with rastrate elements of *B. arca*, *B. confluens* and *Belodina lillianae* n. sp., it is difficult to match eobelodiniform with rastrate elements. In this study, the arched eobelodiniform element is placed with the arched rastrate elements into *B. arca*.

In his synonymy, Sweet (1979a) excluded a compressiform element that was illustrated by Barnes (1977, Pl. 4, fig. 22) as *Belodina leithi* Ethington and Furnish. Having viewed the type specimens of this species from the Melville Peninsula, I have concluded that it is "distinctly bowed to the furrowed side" as defined for *B. arca* by Sweet (1979a, p. 58). In addition to this, the element has a slight arch to the denticles.

In a report, Nowlan (1995) recorded *Belodina arca* from strata of possible Irene Bay Formation on Ellesmere Island.

Material. 99 elements in the Amadjuak Formation, 1 in the Akpatok Formation (100 elements total).

Belodina aff. *arca* Sweet

Plate 2, figure 7

aff. *Belodina arca* SWEET, 1979a, p. 58–59, Fig. 6(19).

Types. Figured specimen GSC 116745.

Remarks. A few rastrate grandiform elements have the radiating pattern of denticles that typifies *Belodina arca* and distinguishes it from other species of *Belodina* (Sweet, 1979a, p. 58–59). However, these have considerably fewer denticles than in *B. arca* – five versus nine or ten (the illustrated element is relatively small, other elements are similar in size to typical *B. arca*). Another difference is the wider basal heel, and a straighter lower cusp margin. Like other species of *Belodina*, this form has a spatulate cusp.

Material. Three elements in the Amadjuak Formation (only).

Belodina boltoni n. sp.

Plate 1, figures 8–9

Belodina? sp. BAUER, 1990, Pl. 1, fig. 5.
Belodina sp. BAUER, 1994, p. 363, Fig. 3(25).

Types. Holotype GSC 116713, paratype GSC 116712.

Diagnosis. Apparatus is bimembrate, with variable rastrate (belodiniform) and eobelodiniform elements having broad and long cusps. Both elements have panderodont furrow and groove on one side, the other face is smooth. Outer face is convex, inner face by inflection point is concave.

Description. Rare belodiniform (?compressiform) element has short base, high heel, and broad and long cusp. Basal rim is thick. Posterior margin of base is broadly convex to nearly straight, lower margin tightly convex giving a "V"-shaped outline. Anterior margin of heel is convex; upper margin of heel is oblique relative to panderodont furrow on base. Panderodont groove extends along cusp on one face, other face is smooth. A faint dimple occurs on base between lower margin and furrow. Cusp is lanceolate and proclined. Two erect denticles lie between heel and cusp. These are not as long as the heel. White matter is in denticles and cusp, but not in posterior edge of cusp. White matter in cusp extends into base below denticles, almost to posterior edge of base.

Eobelodiniform element has short base, high heel, and broad and long cusp. Basal rim is thick. Posterior margin of base is slightly convex from lower margin to level of geniculation point and concave from there to tip of heel. Lower margin of base is nearly parallel with panderodont groove and furrow, giving base a "U"-shaped outline. Anterior margin of heel is almost straight to broadly convex, upper margin of heel is oblique relative to panderodont furrow on base. Panderodont groove extends along cusp on one face, other face is smooth. Cusp is lanceolate and

proclined, almost erect. White matter is in cusp, but not in its posterior edge. White matter extends almost to posterior edge of base.

Remarks. The two elements perhaps should be regarded tentatively as a species of *Belodina* because the apparatus lacks two different rastrate elements. The one rastrate element may correspond to the compressiform element. The elements are rare in the Frobisher Bay Formation and thus a grandiform element that might belong to the apparatus could yet be found. The similar size, and similar white matter distribution supports the apparatus reconstruction.

Belodina? sp. and *Belodina* sp., illustrated from the late Early and early Middle Ordovician (Bauer, 1990 and 1994, respectively) are eobelodiniform elements like that found in this Frobisher Bay appraratus. As Bauer (1994) notes, there are differences in the cusp of his species and *B. calciprominens* Sweet. The heel of both are quite different as well; in the present species it is higher and more narrow than in the same element of *B. calciprominens*.

Some eobelodiniform elements of *Belodina confluens* illustrated by Trotter and Webby (1994, Pl. 2, fig. 27) and Zhen and Webby (1995, Pl. 1, fig. 18) have a nearly square lower margin as in this element, but the cusp is much shorter.

Derivation of name. In memory of Thomas E. Bolton.

Material. 31 elements in the Frobisher Bay Formation (only).

Belodina confluens Sweet

Plate 1, figures 10–11; Plate 2, figures 8–10

Belodina compressa (Branson and Mehl). ATKINSON, 1971, p. 82–83, Pl. 5, fig. 13, 15, 16.

Belodina confluens SWEET, 1979a, p. 59, 60; Fig. 5(10, 17), Fig. 6(9) [includes synonymy]; NOWLAN 1983, p. 662, 664, Pl. 3, fig. 3, 4 [includes synonymy]; CRAIG, 1986, Pl. 2, fig. 35; McCRACKEN, 1987, Pl. 1, fig. 1–4; PEI and CAI, 1987, p. 70; Pl. 9, fig. 9, 14, Pl. 14, fig. 14–16, text-fig. 3(23, 24); NOWLAN and McCRACKEN *in* NOWLAN et al., 1988, p. 12, Pl. 1, fig. 16–21; McCRACKEN and NOWLAN 1989, p. 1888; Pl. 1, fig. 19–21, Pl. 2, fig. 1, 2; AN, *in* AN and ZHENG, 1990, Pl. 10, fig. 13; BERGSTRÖM, 1990, Pl. 3, fig. 8–12; POHLER and ORCHARD, 1990, Pl. 4, fig. 15; UYENO, 1990, p. 71–72, Pl. 1, fig. 8, 9; WANG, et al., 1993, Pl. 30, fig. 12; TROTTER and WEBBY, 1994, p. 481, Pl. 2, fig. 18–20, 24, 25, 27–30 [includes synonymy]; ZHEN and WEBBY, 1995, Pl. 1, fig. 16–18 [includes synonymy]; NOWLAN and McCRACKEN *in* NOWLAN et al., 1997, Pl. 1, fig. 1, 2; Pl. 3, fig. 5, 6, 9. 10.

aff. *Belodina confluens* Sweet? TROTTER and WEBBY, 1994, p. 481, Pl. 2, fig. 7; ZHEN and WEBBY, 1995, Pl. 1, fig. 19–21.

aff. *Belodina* aff. *B. confluens* Sweet. ARMSTRONG, 1990, p. 128, 129, Pl. 22, fig. 14, 15.

Types. Hypotypes GSC 116714–116715, 116746–116748.

Remarks. The lowest occurrence of *Belodina confluens* is at Jordan River (Section 11) in the Frobisher Bay Formation (Pl. 1, fig. 10, 11). The compressiform element has the characteristic arcuate anterior margin rather than a straight segment on this margin as in *B. compressa* elements (Sweet, 1979a). The species is also found in the Amadjuak Formation (Pl. 2, fig. 8–10). On this plate, the illustrated grandiform element (Pl. 2, fig. 9) was chosen because of its extremely developed spatulate cusp. The eobelodiniform element of *Belodina confluens* is discussed below under *Belodina arca* Sweet.

Material. 76 elements in the Frobisher Bay Formation, 1348 in the Amadjuak Formation (1424 total).

Belodina lillianae n. sp.

Plate 2, figures 11–13

Belodina aff. *B. stonei* Sweet, 1979a. McCRACKEN and NOWLAN, 1989 (in part), p. 1898, Pl. 2, fig. 3, 6–8, 11, 12 (only; Pl. 2, fig. 4, 5, 9, 10 in *B. stonei* Sweet, below).

Types. Holotype, GSC 116749, paratypes, GSC 116750–116751.

Diagnosis. Tri- or quadrimembrate apparatus. Grandiform element has broad basal heel and erect denticles. Compressiform element has a relatively long heel. Posterior margin of heel of grandiform and compressiform elements is reclined. In all elements, base below furrow is posteriorly extended and has a convex margin. All elements have a thickened basal rim.

Description. One form of grandiform element is unbowed, another (Pl. 2, fig. 11) is bowed to inner, furrowed side. All have long basal heels and erect denticles and a long, thick costa on the inner anterior margin. All have a panderodont groove and furrow on one side (inner). Other (outer) face is acostate. Basal margin between furrow and anterior (lower) margin is convex and extends posteriorly past furrow end. Basal rim is thick. Posterior margin of heel is angled toward posterior.

Denticle tips are generally higher than heel and can either form a straight or curved line. Number of denticles ranges from five to seven, with six denticles being most common. White matter occurs in cusp and denticles.

The compressiform element has a relatively broad heel, is straight, not bowed, denticles are in a slightly radiate pattern, and a short, thick costa is found on the inner anterior margin. Basal margin between furrow and anterior (lower) margin is convex and extends posteriorly past furrow end. Basal rim is thick. Posterior margin of heel is angled toward posterior. The upper margin of the heel and the slightly higher denticle tips form an arch. Number of denticles varies from four to five. White matter is in cusp and denticles.

The eobelodiniform element has a short, broad, and erect cusp. It is slightly bowed, and has a panderodont cusp groove and basal furrow on its outer side. The convex basal margin between the furrow and anterior (lower) margin extends more posteriorly than does the posterior margin of the heel. Basal rim is thick. White matter is in cusp.

Remarks. The grandiform element is the most distinguishable element, primarily on the basis of the long heel. The heel of the compressiform element is not as long as the heel of grandiform elements, and on its own, is difficult to distinguish from the heel of the compressiform element of *Belodina stonei*.

McCracken and Nowlan (1989) found their species in the Red Head Rapids Formation (Richmondian) of Southampton Island. A difference they noted between their species and *Belodina stonei* and other species was the relatively long (i.e., broad) heel on the grandiform elements. The heel of the grandiform is noticably broader than in all other species of *Belodina*. *Belodina monitorensis* Ethington and Schumacher (1969) was originally described as having a short and high (with current element orientation = low and broad) heel. Even so, it is not as broad as in this new species. Also, *B. monitorensis* typically has five denticles (Ethington and Schumacher, 1969), and as few as three (Bauer, 1987), fewer than found in this new species.

In terms of relative width of denticles, the heel on grandiform elements is typically as wide as the proximal four or five denticles. On the syntype of *B. stonei*, the width equals two denticles (three in *B. stonei* of this study), and these widths on the holotypes of *B. confluens* and *B. monitorensis monitorensis* s.f. correspond to three denticles.

Compressiform elements can be distinguished from co-occurring compressiform elements of *Belodina arca* by their lack of significant bowing, and lower heel. Distinguishing between compressiform elements of *B. confluens*, *B. compressa*, and *Belodina lillianae* n. sp. is more difficult. All have similar numbers of denticles. Using a characteristic described by Sweet (1979a), compressiform elements of both *B. confluens* and *Belodina lillianae* n. sp. have smoothly arcuate anterior margins, thus differing from *B. compressa*, which has a short, straight segment near the anterobasal corner. The compressiform element of *Belodina lillianae* n. sp. can be distinguished from the same elements in *B. compressa* and *B. confluens* by the difference in the posterior (aboral *in* McCracken and Nowlan, 1989) margins. Both the latter species have a more or less straight, or slightly sinuous posterior margin. This margin characteristic is true for all three element morphotypes of *B. confluens*, *B. compressa*, and *Belodina lillianae* n. sp. (cf. *B. confluens*, p. 71, Pl. 2, fig. 1–4 and *B. compressa*, ibid., fig. 8–14, *in* Sweet *in* Ziegler, 1981) and *Belodina lillianae* n. sp. (herein). The compressiform element of *Belodina stonei* has a tighter radius of curvature.

More discussion of eobelodiniform elements is found above under *Belodina arca*.

McCracken and Nowlan (1989) commented that a similar form of heel on rastrate belodiniform elements was found in unpublished material by Marcil (1984) in Edenian–Maysvillian rocks at Aberdeen Lake, District of Keewatin.

Derivation of name. In honour of my mother, "Lilyan".

Material. 60 elements in the Amadjuak, 76 in the Akpatok and 19 in the Foster Bay formations (155 elements total).

Belodina stonei Sweet

Plate 4, figures 10–11

Belodina stonei SWEET, 1979a, p. 60; Fig. 6(20, 27); PEI and CAI, 1987, p. 70–71, Pl. 14, fig. 19–26, text-fig. 3(21, 24).

Belodina aff. *B. stonei* Sweet, 1979a. McCRACKEN and NOWLAN, 1989 (in part), p. 1898, Pl. 2, fig. 4, 5, 9, 10 (only; Pl. 2, fig. 3, 6–8, 11, 12 in *B.* n. sp. above).

aff. *Belodina* aff. *stonei* Sweet. MARTINOV and MELNIKHOV, 1993, 1 fig. (unnumbered).

Types. Hypotypes GSC 116813–116814.

Remarks. The elements of *Belodina stonei* on Baffin are generally much larger than elements of *B. confluens* found in lower strata. From the original description by Sweet (1979a, p. 60), the grandiform element has a cusp that is broadly rounded apically and thus differs from the spatulate and acutely rounded or apically pointed cusps of *Belodina compressa* and *B. confluens*. Compared to the grandiform element of *B. arca*, this element lacks the distinct radiate denticle pattern, and has a more regularly curved anterior margin, a broader and lower heel, and shorter, broader, and

fewer denticles. The grandiform element of *B. stonei* as defined has six or fewer denticles (Sweet, 1979a); in the Baffin collections, it was found that many elements had seven denticles (cf. Pl. 4, fig. 10). The heel is not as broad, the posteriormost denticle is reclined rather than erect as in the grandiform element of *Belodina lillianae* n. sp.

The compressiform element has five or fewer denticles (Sweet, 1979a, p. 60, stated "four or fewer", but larger elements from Baffin have five). Its heel is markedly inclined toward the furrowed inner side, which also has an elongate, dimplelike depression between furrow and the anterior margin. This element has a distinctly shorter radius of curvature than the same elements of *Belodina compressa*, *B. confluens*, and *Belodina lillianae* n. sp. It is also more bowed. Also, the heel is broader than in *B. compressa* and *B. confluens*. The broad heel and short radius results in fewer denticles in this species than in *B. compressa* and *B. confluens*.

Belodina stonei and *B. lillianae* n. sp. occur together on Southampton Island and it seems McCracken and Nowlan (1989) combined compressiform elements into the one species, *Belodina* aff. *stonei*. On Baffin, these two species are particularly abundant at two sections (S10 – Amadjuak Formation, GSC loc. O-104510 for *B.* n. sp. A; S8 – Akpatok Formation, GSC loc. O-104502 and O-104223). In the former, *Belodina arca*, *B. confluens* and *B. lillianae* n. sp. occur together in the absence of *B. stonei*; at Section 8, *Belodina stonei* and *B.* n. sp. occur together in the absence of *Belodina arca* and *B. confluens*. This distribution is used to assign compressiform elements in Section 8 to either *Belodina stonei* or *B. lillianae* n. sp.

At present, the eobelodiniform cannot be distinguished from that of *Belodina lillianae* n. sp.

Material. 318 elements in the Akpatok Formation, 152 in the Foster Bay Formation (470 elements total).

Belodina? n. sp. B

Plate 2, figures 14–15

Types. Figured specimens GSC 116752–116753.

Description. Large eobelodiniform element, with short sharp cusp and long heel. Cusp length slightly shorter than or slightly longer than heel. Outer face is convex and has panderodont groove and furrow. Inner face of heel is concave. Inner face of cusp is strongly carinate. Element is bowed to inner, non-furrowed side. Base is extended downward such that base and heel in profile are about equal in length. Aboral margin is convex, inner face of base is strongly flared below cusp. White matter in cusp, and on outer face; it extends into base on the lower side of the furrow. One element differs in that the heel is short.

Remarks. This is a rare element in the Amadjuak Formation. The size is variable, although some are large (over 2 mm long). The short heel of the second element does not appear to be due to fracture.

The eobelodiniform element of *Belodina* sp. F illustrated by Trotter and Webby (1994, Pl. 2, fig. 26) is close to this element in outline, except that its base does not extend downward as much as in this element.

Material. 3 elements in the Amadjuak Formation (only).

Genus *Coelocerodontus* Ethington, 1959

Coelocerodontus trigonius Ethington

Plate 4, figures 15–19

Coelocerodontus trigonius ETHINGTON, 1959, p. 273; Pl. 39, fig. 4; WEBERS, 1966, p. 25, Pl. 2, fig. 12, 13a, b; 14; GLOBENSKY and JAUFFRED, 1971, p. 54, Pl. 2, fig. 2; AN, DU and GAO, 1985, Pl. 10, fig. 16; NOWLAN and McCRACKEN *in* NOWLAN et al., 1988, p.14–15, Pl. 3, fig. 1–5, 8–10; [includes synonymy]; McCRACKEN and NOWLAN, 1989, p. 1888–1889, Pl. 2, fig. 18; AN *in* AN and ZHANG, 1990, Pl. 4, fig.10, 14, 15; ZHANG, 1998, p. 56, Pl. 5, fig. 1–4 [includes synonymy].

?*Sagittodontus robustus* Rhodes. WEYANT, 1968, p. 61, Pl. 6, fig. 6.

Types. Hypotypes GSC 116818–116822.

Remarks. The Baffin material might be the most extensive collection of this species. With over 600 elements I believe it has a more complex apparatus than usually described. Two forms are commonly placed within this species – trigoniform and tetragoniform elements. Nowlan and McCracken (*in* Nowlan et al., 1988) described subtle variations in both elements, suggesting that the apparatus either contained two forms, or three (i.e., up to two varieties of trigoniform, and one tetragoniform). Three additional rare and squat elements with three, four, and five costae are recognized here and included within an expanded interpretation of *Coelocerodontus trigonius*. These alternatively might represent a new species, but it would differ from typical *C. trigonius* in the number of distinct element morphotypes.

The three new elements are short-based and shorter, less recurved, and more pyramidal and stout than the other two. One has three costae and so is like the trigoniform element. The important difference is the placement of the three costae.

On the trigoniform element, the two lateral costae are anteriorly situated, and the third is on the posterior margin. This gives the element a convex anterior face and two concave posterolateral faces. The pyramidal element with three costae has two lateral costae that are posteriorly placed, and an anterior costa. Thus in this element, the posterior face is acostate and concave, and the two anterolateral faces are convex. This arrangement can be seen in the two illustrated elements, both of which are lateral views – the highlighted face between the two lateral costae of the pyramidal element (Pl. 4, fig. 17) is the posterior face (compare with the trigoniform element in Pl. 4, fig. 15). Another form of pyramidal element has four costae (Pl. 4, fig. 18), but the costae positions differ compared to those in the tetragoniform element. Two costae are lateral, the other two are anterior and posterior. The third form of pyramidal element is like the second, but has a another lateral costa for a total of five costae (Pl. 4, fig. 19).

An element similar to the three-costae pyramidal form is *Sagittodontus robustus* Rhodes as figured by Weyant (1968) from the (?) Allen Bay Formation of the high Arctic Islands. He found five of these elements in the same sample as trigoniform and tetragoniform elements, and compared these to trigoniform elements of *Coelocerodontus*.

Ratios were determined in two samples. In the Amadjuak Formation (GSC loc. O-104536), of the 220 elements, the ratio of trigoniform:tetragoniform:pyramidiform is 6.29: 1.00:1.33. The ratio of the same elements in the Foster Bay Formation (GSC loc. O-104503) is 8.02:1.00:1.15. This indicates that the pyramidiform element is about as common as the tetragoniform element.

Material. One element in the Frobisher Bay, 236 in the Amadjuak, 161 in the Akpatok, 339 in the Foster Bay formations (737 elements total).

Genus *Culumbodina* Sweet, 1979a

Culumbodina n. sp. X

Plate 2, figures 18–19

Types. Figured specimens GSC 116756–116757.

Remarks. Both elements in this assemblage are asymmetrically triangular in lateral view. The cusp is short and slightly recurved. The two elements differ in that one has a denticulated margin, the other is adenticulate.

Material. 3 elements in the Amadjuak Formation (only).

Genus *Oulodus* Branson and Mehl, 1933

Oulodus velicuspis (Pulse and Sweet)

Plate 2, figures 22–26

Prioniondina velicuspis PULSE and SWEET, 1960, p. 259–260, Pl. 36, fig. 5, 13. [M element]

Types. Hypotypes GSC 116760–116764.

Remarks. One of the M elements is very similar to the same element illustrated as *Oulodus velicuspis*? by McCracken and Nowlan (1989, Pl. 2, fig. 20). Their sample (GSC loc. C-151098) was from organic-rich strata on Amadjuak Lake, Baffin Island (lower Amadjuak Formation, see Section 14).

The most distinctive element is the M element (as per the type species), which was described as having "a broadly spatulate cusp" by Sweet and Schönlaub (1975, p. 48, Pl. 2, fig. 6). None of the few Baffin examples of this element have as distinctive a cusp "spatula" as the type species. However, they do have a small, reclined denticle placed tightly against the base of the cusp, and the cusp flares slightly outward over its location. If this denticle were broken, the cusp would appear similar. This arrangement is best seen in one of the samples (Pl. 2, fig. 25) where the denticle is missing, and in McCracken and Nowlan's figure (1989, Pl. 2, fig. 20).

The M element of *Plectodina aculeata*, which also occurs in the Amadjuak Formation, lacks this arrangement (see Pl. 3, fig. 3).

Material. 19 elements in the Amadjuak Formation (only).

Genus *Periodon* Hadding, 1913

Periodon aff. *grandis* (Ethington)

Plate 1, figure 14; Plate 2, figures 28, 29

aff. *Loxognathus grandis* ETHINGTON, 1959, p. 281; Pl. 40, fig. 6.

aff. *Periodon grandis* ETHINGTON. BERGSTRÖM and SWEET, 1966, p. 363–365, Pl. 30, fig.1–8 [includes synonymy]; WEBERS, 1966, p. 58, Pl.12, fig. 8; SWEET and BERGSTRÖM, 1969, p. 167, Pl. 5, fig. J–M; GLOBENSKY and JAUFFRED, 1971, p. 57, Pl. 3, fig. 1, 4–7, 13, 16 [includes synonymy]; SWEET, THOMPSON and SATTERFIELD, 1975, Pl. 3, fig. 6, 16; BARNES, 1977, p. 107, Pl. 4, fig. 6, 7 [includes synonymy]; SWEET, 1979a, Fig. 8(20, 21); SWEET,

1983, Pl. 3, fig. 11, 17; SWEET, 1979b, p. G19; McCRACKEN and NOWLAN, 1989, p. 1889, Pl. 3, fig. 7–9; BERGSTRÖM and MITCHELL, 1992, Pl. 1, fig. 19–21. WANG, et al., 1993, p. 190, Pl. 35, fig. 18–21; TROTTER and WEBBY, 1994, p. 484, Pl. 4, fig. 13, 14, 27, 28; ZHEN and WEBBY, 1995, Pl. 4, fig. 3, 4. [includes synonymy].

aff. *Periodon* n. sp. aff. *P. grandis* (ETHINGTON). HARRIS, BERGSTRÖM, ETHINGTON and ROSS, 1979, Pl. 4, fig.14–16.

Types. Figured specimens GSC 116718, 116766–116767.

Remarks. Bergström and Sweet (1966, p. 365) noted that the falodus-like element of *Periodon grandis* is the most diagnostic character. This has a large, subtriangular base and nearly straight basal margin. It also has "anterior denticles that are closely appressed to the anterior margin of the cusp" whereas the same element of *Periodon aculeatus* has denticles "being developed on a more or less conspicuous anterior process". Kennedy et al. (1979, p. 544) further noted that the "periodoniform elements" of *Periodon grandis* had hindeodellid denticulation but those of *Periodon aculeatus* did not. These latter authors found that about 10 per cent of the falodiform elements in their single Middle Ordovician faunule were indistinguishable from those of *Periodon grandis*, and that a few others were morphologically transitional between the two forms. Since the periodontiform elements lacked hindeodellid denticulation, and most falodiform elements were of the *aculeatus*-type, their species is truly *Periodon aculeatus*.

The periodontiform elements of the Baffin faunas have hindeodellid denticulation, but most of the falodiform elements have a convex basal margin and a long straight posterior portion of the base and so are reminicent of *Periodon aculeatus*. Many have "appressed" denticles, but others, especially large ones, have a rudimentary anterior denticulated process. As Bergström and Sweet (1966) noted for *Periodon grandis*, some specimens (small ones) of the falodiform elements have only inconspicuous denticulation, or perhaps lack denticulation.

This species is regarded as a morphologically transitional form between *Periodon aculeata* and *P. grandis*.

Material. Eight elements in the Frobisher Bay Formation, 7789 in the Amadjuak Formation (7797 total).

Genus *Pseudobelodina* Sweet, 1979a

Pseudobelodina adentata Sweet?

Plate 1, figures 20–21; Plate 3, figures 11, 12

Eobelodina sp. s.f. BARNES, 1977, p. 106, Pl. 4, fig. 13.

?*Pseudobelodina adentata* SWEET, 1979a, p. 68; Fig. 5(23); Fig. 6(2, 4, 10, 14); ELIAS, NOWLAN and BOLTON, 1988, Pl. 5, fig.11, 12; AN *in* AN and ZHENG, 1990, Pl. 7, fig. 16, 17, 19.

cf. *Pseudobelodina* cf. *P. adentata* SWEET. NOWLAN and MCCRACKEN *in* NOWLAN et al., 1988, p. 30, Pl. 12, fig. 1–7.

Types. Figured specimens GSC 116724–116725, 116780–116781.

Remarks. The species is not well known, and the Baffin Island specimens are questionably assigned to it because they all are heeled, adenticulate elements. The two illustrated elements from the Frobisher Bay Formation are both eobelodiniform elements and are distinguished by cusp inclination and the direction of bowing. The S element (Pl. 1, fig. 20) is bowed to the unfurrowed side whereas the P? element (Pl. 1, fig. 21) is bowed to the furrowed side. The cusp is strongly proclined in the latter, and weakly proclined, nearly erect in the S element. Unlike the type material, the eobelodiniform elements from the Frobisher Bay Formation lack an anterolateral costa, and perhaps significantly, the curvature differs.

The two elements from the Amadjuak Formation (Pl. 3, fig. 11, 12) do have an anterolateral costa, but again the curvature differs. In the illustrated type material (Sweet, 1979a) the anterior margins of all elements have a curvature that begins low on the base, whereas in these specimens, the inflection point is more anterior. Sweet (1979a) questionably included *Eobelodina* sp. s.f. of Barnes (1977) in his synonymy. Barnes' species, *Eobelodina* sp. s.f., was from the Bad Cache Rapids Formation (correlates with the Amadjuak Formation on Baffin Island) of Melville Peninsula. The specimen illustrated by Barnes has an curvature inflection point like the Baffin Island material rather than the type material. Hence, in the synonymy above, it is regarded as a synonym, and Sweet's (1979a) species is tentative.

In two reports, Nowlan (1994) identified *Pseudobelodina adentata* from strata of the Surprise Creek Formation, northern Manitoba, and possible Irene Bay Formation on Ellesmere Island (Nowlan, 1995).

Material. 16 elements in the Frobisher Bay Formation, 5 in the Amadjuak Formation (21 total).

Genus *Pteracontiodus* Harris and Harris, 1965

Pteracontiodus sp. A

Plate 1, figures 26–27

Types. Figured specimens GSC 116730–116731.

Remarks. These few distinct hyaline elements compare to elements that previously have been assigned to a number of genera. Bauer (1987) noted confusion over the relationship of *Scandodus*, *Triangulodus*, *Trigonodus* and *Tripodus*. He also suggested that his *Triangulodus alatus* Dzik might alternatively be reassigned to *Pteracontiodus*. Sweet (1988) discussed the similar genera *Eoneoprioniodus*, *Triangulodus*, *Trigonodus* and *Pteracontiodus*, and suggested that the last named was the senior synonym. Bauer (1994) has since used the name *Pteracontiodus*; I follow Sweet's and Bauer's interpretations herein.

Barnes (1977) reported *Eoneoprioniodus bialatus* and *E. bilongatus* (Harris) from one sample of the Ship Point Formation on Melville Peninsula, and assigned the conodont faunas to conodont faunas 2 and 3 of Sweet et al. (1971). Barnes (*in* Workum et al., 1976) also described similar elements (as *Oistodus akpatokensis* Barnes) from Fauna 2, which Barnes (1977) thought were not conspecific with his two Melville species.

In his unpublished dissertation, Nowlan (1976) described a new genus and species from the upper part of the Bay Fiord Formation (Fauna 6/7) that has similar hyaline and keeled elements. He chose to establish a new genus rather than to broaden the interpretation of *Eoneoprioniodus*; this may be related to these other mentioned Arctic species.

Material. 42 elements in the Frobisher Bay Formation (only).

Genus *Staufferella* Sweet, Thompson and Satterfield, 1975

Staufferella n. sp. A

Plate 4, figures 30–32

Types. Figured specimens GSC 116833–116835.

Remarks. The illustrated symmetrical element has a rounded posterior face on its distal and proximal parts (note that the base is broken). In the middle third, the posterior face has two rounded costae enclosing a groove, which is reminiscent of *Staufferella falcata*. Since the base of the illustrated symmetrical element is broken, it is not known if the element possessed baso-lateral alae. The alae of the asymmetrical elements are much more developed than in similar elements of *S. falcata*.

Material. Four elements in the Akpatok Formation, six in the Foster Bay Formation (10 elements total).

Genus *Taoqupognathus* An *in* An et al., 1985

Taoqupognathus philipi Savage

Plate 1, figure 28

Taoqupognathus philipi SAVAGE, 1990, p. 828–829, Fig. 8(1–12); ZHEN and WEBBY, 1995, p. 287, Pl. 5, fig. 7–12.

Types. Hypotype GSC 116732.

Remarks. The illustrated element is most like the holotype of *Taoqupognathus philipi* (cf. Savage, 1990, Fig. 18.11–18.12). Savage (1990) referred to this form as a zeta element; Zhen and Webby (1995) called the same element the Sc5 element. It is from the lowest level of the Frobisher Bay Formation at Section S16 (O-104479). The species is very rare in the Baffin collections; other than the illustrated form, only one other element was registered.

Material. One element in the Frobisher Bay Formation, one in the Amadjuak Formation.

Genus *Yaoxianognathus* An, *in* An et al., 1985

Yaoxianognathus? *tunguskaensis* (Moskalenko)

Plate 3, figures 25–30

Phragmodus? *tunguskaensis* MOSKALENKO, 1973, p. 74, Pl. 12, fig. 1–3.

Yaoxianognathus? *tunguskaensis* (Moskalenko). TROTTER and WEBBY, 1994, p. 488–489, Pl. 4, fig. 18–20 [includes synonymy]; ZHEN and WEBBY, 1995, p. 289–290, Pl. 6, fig. 22.

Types. Hypotypes GSC 116794–116799.

Remarks. I recognize an apparatus consisting of at least six elements: Sc (eoligonodiniform), Sb (zygognathiform), Sa (trichonodelliform), M (falodiform), Pa (prioniodiniform), Pb (nathaniform). A seventh element, Pc (oulodiform), is likely part of the apparatus. Denticulation is hindeodellid, with small denticles between larger. The denticulation is discrete in most elements, but confluent on some processes.

Material. 175 elements in the Amadjuak Formation (only).

N. Gen. A n. sp. A McCracken

Plate 4, figures 33–34

New genus A new species A McCRACKEN, 1987, p. 1461, 1462, Pl. 1, fig. 13, 15–22, 24.

Types. Figured specimens GSC 116836–116837.

Remarks. McCracken (1987) fully described this as a rare association of asymmetrical (his *a* element) and symmetrical (his *c* element) rastrate elements. What characterized this association is the bifurrowed symmetrical element, and thus he thought that the species did not belong under other rastrate genera such as *Belodina*, *Culumbodina*, *Parabelodina*, or *Pseudobelodina*.

On Baffin, only four of the symmetrical elements have been found. McCracken (1987) reported it also from an unpublished collection from the Cape Phillips Formation on west-central Cornwallis Island, in the Canadian Arctic, in addition to its occurrence in the late Richmondian *G. ensifer* conodont Zone of northern Yukon.

Its association with *Pseudobelodina*? *dispansa* in the Yukon, on Cornwallis Island, and here, and its proclined denticles suggest it may be part of this species.

Material. Two elements in the Akpatok Formation, two in the Foster Bay Formation (four elements total).

INCERTAE SEDIS

Milaculum ethinclarki Müller, 1973 (Plate 3, fig. 31)

Remarks. This has been described as a dog-biscuit-shaped form of *Milaculum*. (Ethington and Clark, 1981). McCracken and Nowlan (1989) found one element from their Amadjuak Lake locality.

Milaculum sp. A (Plate 1, fig. 31, 32)

Remarks. This is a bulbous, or hemispherical form of *Milaculum* that has a nearly circular basal outline.

Milaculum sp. B (Plate 3, fig. 32)

Remarks. This is a rare, rectangular form of *Milaculum*. The ornamentation consists of low nodes on one half, and higher nodes on the other.

Milaculum sp. D (Plate 3, fig. 33)

Remarks. This is a form of *Milaculum*, with a nearly square or rectangular basal outline.

Phosphannulus universalis Müller, Nogami and Lenz, 1974 (Plate 3, fig. 34)

Ptiloncodus harrisi Bordeau, 1972 (Plate 1, fig. 33)

Remarks. Ptiloncodus harrisi lacks the two "flattened, subovate, auricular lobes" (Harris, 1962, p. 207), also described by Ethington and Clark (1981, p. 122) as "Mickey Mouse ears" found on *P. simplex* Harris, and instead has two rounded knobs on the base of the hook.

Indeterminate hook with base (Plate 1, fig. 34)

Remarks. This element is superficially like *Ptiloncodus*, which is found in higher strata, but differs in that the base is excavated. It is not common; fewer than 20 specimens were found, all in the Frobisher Bay Formation.

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Appendix 4.1
Section and sample notes

The following are field notes on sections and samples studied during 1988 and 1989. Section locations and numbers are the same as used in this volume by Sanford and Grant. Their logs give a more detailed, overall picture of the sections. Presented here are details of the conodont and most other fossil collections. The latter are reported separately in this volume by Bolton, Copeland, Riva, and Asselin et al. Numbers are GSC locality numbers, and locality data are stored at the Ottawa office of the Geological Survey of Canada. Unless noted otherwise, all stratigraphic measurements are made from the bases of the sections.

Section	GSC loc.	Description
1 Hone River	O-104209	Hone River section at faulted Paleozoic–Precambrian contact, lat. 64°13'45"N; long. 70°37'00"W. ***Amadjuak Formation:*** from very rubbly weathering beds exposed at base of section, about 1.5 m above water level (i.e., 1.5 m), upper 10 cm of 30 cm bed; greenish blue weathering, greenish grey, argillaceous fine calcarenite and calcilutite; small crinoid ossicles, rare trochoid gastropods, thumb sized nautiloid; fossils fragmentary.
	O-104210	from resistant unit, 15 cm bed about 1.5 m below top of exposure (= 15.5 m), immediately opposite rapids at right-angle turn in river, overlain by nodular limestone; medium grey, weathering, brownish grey fine calcarenite; small crinoid ossicles, some articulated; one chain coral in lower bed.
2 Hone River		Hone River section, downstream from section 1, lat. 64°16'20"N; long. 70°35'20"W. ***Amadjuak Formation:*** many macluritids and receptaculitids found in rubble along shore, few orthocones, including type with compressed, delta-shaped shell, one coiled nautiloid
	O-104211	1 m above water level (= 1.0 m), from 15 cm of nodular weathering, light bluish grey weathering, light medium grey calcilutite; abundant fossil debris (crinoid ossicles, brachiopods).
	O-104212	from talus bearing numerous weathered out horizontal burrows, sampled block from under overhang; level unknown but estimated (from photographs) as about 12–15 m; blue-grey weathering, light brownish grey calcilutite; thin-bedded; less nodular than beds in lower part of section; no visible fossils.
3 Hone River	O-104213	Near mouth of Hone River, lat. 64°30'45"N; long. 70°29'50"W. ***Frobisher Bay Formation:*** about 30 cm above Precambrian contact, from mottled brown and grey weathering, light bluish grey calcilutite, burrowed, fossiliferous; small orthocone nautiloids, trilobite fragments, crinoid ossicles, brachiopod valves; colonial corals common in lower part of outcrop.
	O-104214	from about 0.5 m below top of exposure (=3.0 m); light medium grey and buff weathering coarse calcilutite; long (up to 30 cm) orthocone nautiloids (no preferred orientation), crinoid ossicles, no colonial corals.
4 Hone River		Small stream-cut on west side of hill north of sharp bend in Hone River where it empties into Amadjuak Lake, lat. 64°35'20"N; long. 70°37'15"W. ***Amadjuak Formation:*** common macluritids, less common receptaculitids in thin, nodular weathering, medium grey and buff brown argillaceous calcilutite
	O-104215	just above top of main waterfall on this stream; top of waterfall is 3.75 m above base and 10 m below top of section; from thin (2.5 cm), nodular bed, 3.90 m, bluish grey weathering light grey calcilutite.
	O-104216	nodular, medium grey weathering, light grey brown, coarse calcilutite; no visible fossils but macluritids common in underlying beds; from 5–7.5 cm bed, at top of section (13.75 m).
5 south of Nuvungmiut River	O-104217	Summit of ridge south of Nuvungmiut River, lat. 64°31'30"N; long. 70°10'00"W. ***Amadjuak Formation:*** from 1 m exposure, a 70 cm; level; thin, nodular bedded, medium grey and buff brown weathering, medium brownish grey calcilutite; some crinoid ossicles, common receptaculitids, less common macluritids, one curved nautiloid about 10 cm long.
6 Unnamed lake NW of Sylvia Grinnell Lake	O-104218	On west shore of unnamed lake, lat. 64°15'30"N; long. 69°48'50"W. ***Amadjuak Formation:*** from basal beds at water's edge, light bluish grey weathering, brownish grey calcilutite; fossiliferous, crinoid ossicles, common receptaculitids, macluritids, chain corals.
7 Putnam Highland	O-104219	Stream-cut flowing into small lake at north end of Putnam Highland, lat. 65°19'00"N; long. 73°08'30"W. ***Amadjuak Formation:*** from resistant bed within nodular bedded argillaceous calcilutite, greenish grey weathering, 0.4–0.5 cm; many fossils, especially ostracodes, others include orthid and strophomenid brachiopods, macluritids, trilobite fragments, receptaculitids, rare orthocone nautiloids, crinoid ossicles.

Section	GSC loc.	Description
	O-104220	from upper 10 cm of 1.00–1.35 m resistant unit of thin, nodular, greenish grey weathering, greenish grey argillaceous calcilutite; macluritid in bed.
	O-104221	ostracode mud sample taken from above level of O-104220.
	O-104222	from upper 10 cm of resistant unit (4.9–5.0 m), thin bedded, medium grey and greenish grey calcilutite; crinoid ossicles, trilobite fragments.
8 Amadjuak Lake	O-104500	Small stream-cut west of Amadjuak Lake, lat. 65°00'45"N; long. 75°27'55"W. ***Akpatok Formation:*** section collected in 1988 (O-104223–104225), and in 1989 (1989 Section 3; O-104500–104506): 1.3–1.4 m; thin bedded, medium grey weathering, light brownish grey, coarse calcilutite; some crinoid ossicles, no other fossils visible.
	O-104501	solitary coral, gastropod.
	O-104502	2.40–2.47 m; resistant, thin bedded, medium grey weathering, light brownish grey, coarse calcilutite; common crinoid ossicles.
	O-104223	3.32–3.47 m; medium grey weathering, light grey calcilutite; no visible fossils; some small weathered pyrite nodules in surrounding beds, which weather to limonite and vugs.
	O-104224	***Foster Bay Formation:*** from flaggy talus immediately overlying O-104223 beds (ca. 3.47 m), contact not seen, no exposure of these beds here, light buff weathering, medium to dark brown dolomitic and very petroliferous calcilutite; no visible fossils, no bioturbation (i.e., laminated).
	O-104503	about 4 m; part of discontinuous outcrop of flaggy limestone.
	O-104504	about 2 m above outcrop (?6 m) in flaggy talus.
	O-104505	lithological sample.
	O-104225	***(?) Akpatok Formation:*** by stream, talus block containing large nautiloid (photographed in 1988, collected as O-104506 in 1989); medium grey, slightly greenish weathered, fossiliferous, coarse calcilutite, fresh surface same colour; crinoid ossicles; regarded as from Akpatok because of massive rather than flaggy nature.
	O-104506	macrofossils from talus at base of exposure; mainly large orthocone nautiloids, some of which are short; wide gastropods; one of the orthocones is that discussed above under O-104225, which was not collected in 1988); other talus fossils not collected include trilobite fragments, ?bryozoans.
9 Hone River	O-104226	Section on Hone River, lat. 64°18'00"N; long. 70°30'00"W. ***Frobisher Bay Formation:*** numerous colonial coral colonies, goniocerids, one coiled nautiloid, common orthocone nautiloids: from 2 m above Precambrian strata, in thin (2.5 cm) beds, buff and dark grey brown weathering, light grey, coarse calcilutite; crinoid ossicles, possibly trilobite fragments, some nautiloids, colonial corals in this lower part of section.
	O-104227	within recessive interval at 5.5 m, beds contain colonial corals in place, light grey weathering, light grey, coarse calcilutite with some indeterminate fossil fragments; from 7.6 cm bed.
	O-104228	from topmost bed at 9.5 m; thin, nodular bedded, weathered light grey with orange stains, light grey, coarse calcilutite; crinoidal, orthocone nautiloids, receptaculitids in surrounding beds.
10 1989 sections 4 and 6; Silliman's Fossil Mount		Silliman's Fossil Mount, head of Frobisher Bay, lat. 63°45'00"N; long. 68°56'45"W. ***Amadjuak Formation:*** (designated type section by Sanford and Grant, this volume) GSC loc. O-104229–104235 were collected in 1988, GSC loc. O-104507–104526 were collected in 1989 - first 1989 locality is northernmost part of Silliman's Fossil Mount, a relatively small, mostly talus-covered mound where Miller et al. (1954) collected most of their fossils (this was his northwestern segment, or mound).
	O-104507	0.0–2.0 m; (base of composite section measured from within stream); many fossils, brachiopods, corals, nautiloids, gastropods, trilobites; from talus slope by stream.
	O-104508	0.17–0.28 m; ostracode sample from 3 cm of thin, shaly beds immediately above and below O-104509 bed; mud was dug out so contamination unlikely.
	O-104509	0.20–0.25 m light bluish grey calcilutite, alternates with beds of medium grey laminated calcilutite; small chonetid brachiopods in some beds; maximum of 70 cm exposed here; equivalent to 1988 sample O-104230).
	O-104230	0.20–0.25 m (1988); from lowest beds exposed on north side of creek between northwestern and main mounds, about one third way up creek, in highest beds exposed here, from 7.6 cm bed in interval that is very argillaceous and recessive, light bluish grey weathering, medium blue grey sublithographic calcilutite; no visible fossils; interbedded limestone and laminated limestone, both argillaceous; ostracode mud sample taken (see below).
	O-104231	0.20–0.25 m; ostracode mud sample taken from O-104230 locality.
	O-104510	2.6–2.75 m; nodular weathering medium bluish grey calcilutite.
	O-104511	2.6–2.75 m; one orthocone nautiloid.

Section	GSC loc.	Description
	O-104512	12–26 m; macrofossils from slope talus.
	O-104513	18 m; same bed as 1988 sample O-104229, marker horizon correlated with O-104232 on main mound, 8 m from top of north mound; receptaculitid found at same level.
	O-104229	18 m; from a small subcrop of resistant limestone beds; light brown and orangish brown weathering, brownish grey, coarse calcilutite, thin bedded (5 cm or less); some black, smooth-shelled ostracodes (sample of ostracode-bearing limestone along with caked mud taken from beneath an overhanging bed, so in situ); macrofossil collection taken from washed talus above subcrop for 3 m of slope (brachiopod, bivalve, gastropod, rare trilobite fragments, curved nautiloids, crinoid calices; same bed as O-104513.
	O-104514	18 m; ostracode mud sample from talus at same level as sample O-104513; may contain wash from above; also processed later for conodonts.
	O-104515	18–21 m; macrofossils.
	O-104516	19 m; macrofossils.
	O-104517	21 m; macrofossils.
	O-104518	24–26 m; macrofossils.
	O-104519	26 m; ostracode mud and soil sample from top of mound.
	O-104525	0–76.5 m; macrofossils collected from talus in stream between northwestern and main mounds.
	O-104526	0–26 m; macrofossils collected from talus on walk up mound.
	O-104520	***Central segment*** (of Miller et al., 1954) - from large, main mound immediately south of northwest mound 31.45; ostracode mud sample, 13.5 m above 18 m marker horizon; collected immediately below bed of O-104521.
	O-104521	31.45–31.58 m; from 13 cm interval at base of nodular exposure; very light grey weathering, light greenish grey calcilutite.
	O-104522	31.5–33.0 m; macrofossil collection (processed in error as conodont sample).
	O-104523	macrofossils collected between O-104522–104524.
	O-104524	68.5 m; green, greenish brown, and light brown coarse calcilutite, burrowed, flaggy.
	O-104232	resistant limestone beds, about 1 m exposed just under halfway up mound; light grey weathering, brownish grey calcilutite with fossil fragments, thin bedded, interbedded with argillaceous calcilutite; may correlate with O-104229 level (18 m) on northwestern mound; ostracode sample is from surface so probably represents upper part of hill.
	O-104234	72.5 m; from 2.5 cm bed of thin bedded, nodular, light to medium grey and light buff weathering calcilutite.
	O-104233	76.5 m; from top of about 5 m of exposure on top and east side of main mound, sample levels measured from top down; thin bedded, nodular, medium light grey weathering, light brown crinoidal and coarse calcilutite.
	O-104235	(76.5 m); from top of exposure, as seen from the east; thin bedded (2.5 cm), light grey weathering, medium brown crinoidal calcilutite; small crinoid ossicles on weathered surfaces.
	O-104527	unknown level (?18–76.5 m); trilobite, found in talus during climb up main mound.
11 1989 Section 5; Jordan River	O-104528	Southeast side of large outlier, Jordan River 25 km above its mouth, lat. 63°59'15"N; long. 69°10'00"W. ***Frobisher Bay Formation:*** GSC loc. O-104236–104238 were collected in 1988; GSC loc. O-104528–104535 were collected in 1989 0.0–5.0 m; talus; large orthocone nautiloid.
	O-104236	from beds about 0.5 m above water level; 7.6 cm bed of thin bedded, light grey weathering, greenish brown-grey calcilutite; numerous fossil fragments, crinoid ossicles, brachiopods, trilobites, bryozoans, small corals.
	O-104529	0.0–1.65 m; talus macrofossils from loose blocks; small coral or (?)sponge, (?)receptaculitid, (?)ostracodes.
	O-104530	0.0–1.65 m; in-situ macrofossils, small corals or sponges, orthocone nautiloids, receptaculitids, branching coral or bryozoan.
	O-104531	0.25–0.35 m (same bed as O-104236); light grey weathering greenish brown-grey fossiliferous calcilutite; crinoid ossicles, brachiopods, trilobite fragments, small corals or sponges.
	O-104532	1.45–1.55 m; thin bedded, light grey weathering, greenish brown-grey calcilutite; very small trilobite fragments.
	O-104237	from 7.6 cm bed of thin bedded, greenish grey calcilutite, mottled brown, about 2 m above water level; very small fossil fragments.
	O-104533	2.45–2.55 m (same bed as O-104237); thin bedded, mottled brown, medium and orangish buff-brown weathering, greenish grey calcilutite; very small fossil fragments.

Section	GSC loc.	Description
	O-104534	4.0–4.07 m; mottled grey and light grey medium brown calcilutite; no visible fossils; 30 cm below traceable 10–15 cm recessive interval.
	O-104238	from top bed of exposure at 4.5 m from water level; mottled brown and grey, medium brown calcilutite; one medium sized orthocone nautiloid.
	O-104535	4.9–5.0 m (same bed as O-104238); thin bedded, mottled brown and grey weathering, medium brown calcilutite.
11A 1989 Section 5A; Jordan River outlier		Section continues perpendicular from Jordan River at Section 11 up small creek bed toward large outlier, about 25 km above mouth of Jordan River, lat. 63°59'15"N; long. 69°10'00"W. ***Amadjuak Formation:*** collected in 1989 as Section 5A - located south along gorge at small creek intersection - level above O-104535 not known, but not immediately above
	O-104536	3.0 m near top of 3.25 m of discontinuosly exposed carbonate; medium grey weathering fossiliferous calcilutite; brachiopods, crinoid ossicles, trilobite fragments; uppermost bed of this exposure contains a receptaculitid.
	O-104538	4.5 m; about 0.5 m exposed; black calcilutite; graptolites, small, flat, orthid brachiopods, small pseudogygitid trilobites, tiny crinoid ossicles.
		main exposure of this carbonate begins at 6.5 m; graptolite and crinoid rich, crinoid ossicles commonly articulated, rare trilobites.
	O-104537	4.5–8.0 m (estimated); graptolitic shale talus found in creek; trail of talus can be followed up creek onto Jordan Rive outlier where thin bedded carbonates outcrop.
	O-104539	6.5 m; fragile trilobite shale weathers dark grey to black; graptolites and brachiopods not as common.
		- change in weathered colour of shale at about 8 m to medium blue grey; large pseudogygitids, tiny triartharids are common in upper beds of black weathering shale; some conical chitinous forms as found at Collingwood (?orthocone nautiloids)
		- at 9.5 m, medium grey weathering, brownish grey, coarse calcilutite; fossiliferous; pseudogygitids, trilobite fragments
	O-104541	11.0 m; ostracode mud sample from talus; nodular weathering, bluish grey weathering, brownish grey calcilutite and blue grey shale or mudstone.
		- about 4.5 m to end of rubbly exposure at top of stream valley
	O-104540	11–15.5 m; macrofossils; large orthocone nautiloids, one macluritid.
12 Jordan River		Large outlier, section about 30 km above mouth of Jordan River, lat. 63°59'30"N; long. 69°15'50"W. ***Amadjuak Formation:*** macluritids, nautiloids, coral heads abundant in rubble by stream at this locality; this was one of Macauley's oil shales (cf. C-151097)
	O-104239	from basal bed (0.0 m); thin bedded, nodular, light bluish grey weathering, light bluish grey calcilutite; fossiliferous, thin brachiopod valves, ?trilobite fragments.
	O-104240	from top bed of section (10.0 m); upper 15 cm of thin bedded, nodular, buff brown weathering, medium brown calcilutite; crinoid ossicles, macluritids, nautiloid, brachiopod fragments.
13 Jordan River outlier		Small stream cut on large outlier, lat. 63°58'30"N; long. 69°13'30"W. ***Amadjuak Formation:*** macluritids, receptaculitids present in stream bed.
	O-104241	from 15 cm bed at 0.45 m in very argillaceous, greenish blue calcilutite; thin, nodular and recessive weathering with shaly partings; one orthocone nautiloid, ostracode mud sample from 15 cm below conodont level in 7.6 m interval
	O-104242	from beds at top of waterfall (16 m); thin bedded, nodular, greenish brown and orangish brown weathering, greenish grey calcilutite; beds in this interval rich in macluritids, some of which are very large.
	O-104243	from 21 m; thin bedded, nodular, medium to orangish brown weathering, greenish grey limestone; burrowed, crinoidal, strata contain macluritids.
14 Amadjuak Lake	O-104244–104247	Northwest shore of Amadjuak Lake, section begins at lake level at base(?) of Amadjuak Formation, lat. 65°14'50"N; long. 71°41'00"W. ***Amadjuak Formation:*** from or near lower of two resistant carbonate units near base of section; top of this lower unit is about 2 m
	O-104244	geochemical sample from 15 cm interval immediately below base of resistant carbonate unit.
	O-104245	geochemical sample from same bed as conodont and ostracode sample (see below).

Section	GSC loc.	Description
	O-104246	conodont and ostracode sample, from upper 15 cm of 46 cm bed, 1.85–2.0 m; thin bedded but resistant; light brown weathering, brownish grey, fossiliferous calcilutite; fossil fragments indeterminate; underlain by greenish blue argillaceous calcilutite, very argillaceous in places.
	O-104247	geochemical sample from 15 cm interval immediately above top of resistant carbonate unit.
	O-104248	from immediately over second resistant carbonate unit, which is 80 cm thick; 4.1 m; dark brown, fossiliferous limestone; pseudogygitids, thin orthid and chonetid brachiopods.
	O-104249	from top of section, on top of plateau; about 30 m; medium grey and buff weathering, fossiliferous calcilutite; numerous fossils; brachiopods, crinoid ossicles, beds contain macluritids, one receptaculitid.
15 Amadjuak Lake	O-104250	Small stream gorge cutting rocks stratigraphically higher (30 m above lake level) than section 14, lat. 65°14'25"N; long. 71°41'25"W. ***Amadjuak Formation:*** about 6 m below beds equivalent to top of Section 14 (O-104249); from top bed of waterfall in resistant carbonates, about 2 m above recessive argillaceous unit; thin bedded, greenish blue-grey weathering, fossiliferous greenish grey calcilutite; brachiopods, crinoid ossicles; hormotomid gastropod present in higher beds.
16 Sylvia Grinnell Lake outlier		Small stream-cut at base of small Paleozoic outlier, immediately south of Sylvia Grinnell Lake, lat. 64°05'45"N; long. 69°26'45"W. ***Frobisher Bay Formation:*** (designated type section by Sanford and Grant, this volume): fossiliferous: goniocerids, macluritids (?coiled nautiloids), trilobites, large, and very large ostracodes, orthocone and coiled nautiloids, large colonial coral heads; section not collected in 1988, revisited in 1989 (Section 1989-2); 18 m measured in 1989 (vs. 15 m in 1988).
	O-104479	0.20–0.25 m at water's edge; buff brown weathering, light grey calcilutite; ostracodes, crinoid ossicles, trilobite fragments.
	O-104480	0.30–0.35 m; macrofossil collection, very rich in large ostracodes, orthid brachiopods, crinoid ossicles, trilobite fragments.
	O-104481	1.6 m; curved nautiloid.
	O-104482	1.6 m; orthocone nautiloid.
	O-104483	2.20 m; macrofossils.
		2.20 m: macluritid.
	O-104484	2.25 m: macrofossils.
	O-104485	2.31; macrofossils.
	O-104486	2.2–2.4 m; nautiloid.
		2.35 m: macluritid.
		2.38 m: macluritid.
	O-104487	2.40 m; orthocone nautiloid, etc.
	O-104488:	2.45 m; orthocone nautiloid, macluritid, etc.
	O-104489	2.45–2.5 m; pyrite-rich bed; pyrite weathers to limonite which gives bed orange, pock-marked appearance; coarse, medium grey calcilutite; no visible fossils; below is weathered tabulate coral.
		2.50 m: goniocerid.
	O-104490	2.55 m; ostracode mud sample, from mud overlying bed of sample O-104489; mostly talus and frost heave above.
	O-104491	2.55 m; long, medium-sized orthocone nautiloid.
	O-104492	2.55–2.60 m: macrofossils, second bedding plane above sample O-104489.
	O-104493	4.7 m; macrofossil.
	O-104494	6.45–6.50 m; brownish grey weathering, greenish grey calcilutite; small crinoid ossicles.
	O-104495	11.5 m; from 5 cm of orange and buff weathering, brown calcilutite.
	O-104496	fragment of orthocone nautiloid.
	O-104497	17 m; macrofossils in situ between O-104996 and O-104998; includes goniocerid from talus (which looks as if from same unit).
	O-104498	18.0 m; from 5 cm of buff weathering, medium brown calcilutite; crinoidal.
	O-104499	goniocerids, coral from stream talus (level not known; 0–18.0 m).

Section	GSC loc.	Description
	O-104770	very large, smooth-shelled ostracode (see Copeland, this volume); level unknown (0–18.0 m).
17 1989 Section 1 Putnam Highland escarpment		lat. 65°18'00"N; long. 73°01'36"W, NTS 36H/8 ***Amadjuak Formation:*** note, this site was not visited during the 1988 field season; escarpment, section starts with about 24 m of talus blocks before first of exposure
	O-104471	25.4–25.5 m; from 10 cm of thin (2 cm) bedded, nodular, light grey weathering, brownish grey calcilutite; small crinoid ossicles, small macluritid on bedding plane a couple of beds below.
	O-104472	31.0–31.15 m; lithology same as for O-104471.
	O-104473	32 m; ostracode sample, from mud covering bedding plane; mud is wash from overlying beds; in situ receptaculitid.
	O-104474	macluritid (talus).
		34 m: macluritid.
		36–37 m - beds more resistant than below.
	O-104475	36.9–37.0 m; medium bedded, light grey weathering calcilutite; very small crinoid ossicles; receptaculitids, macluritids in this unit; bedding plane surfaces are burrowed but burrows not weathered out as in lower beds.
		37 m - orthocone nautiloid, receptaculitid.
		39.0–44.0 m - intensely burrowed unit; macluritid bearing.
	O-104476	40.4–40.5 m; massive, resistant weathering, medium grey and buff weathering, brownish grey calcilutite; very small crinoid ossicles.
	O-104477	44 m; lithology as for O-104476, but weathers into thin beds; top of exposure at this locality, but section does continue about 10–15 m higher to the northwest.
	O-104478	four macluritids, two curved nautiloids; talus between 40.5–44 m.

PLATES

Numbering system is as follows:

MJB_135 [SEM digital file number], (190-20) [SEM stub number], GSC 116705 [type specimen number], x83.3 [magnification], GSC loc. O-104227 [GSC locality number].

All illustrated specimens on the following plates are in repository with the National Type Collection of Invertebrate and Plant Fossils, Geological Survey of Canada, Ottawa, Ontario K1A 0E8. All illustrations are lateral views of hypotypes except where noted.

PLATE 1

Frobisher Bay Formation, conodonts and incertae sedis

Figure 1. *Amorphognathus tvaerensis* Bergström? Sa element. MJB_135 (109-20), Figured specimen GSC 116705, x83.3. GSC loc. O-104227.

Figures 2–4. *Ansella nevadensis* (Ethington and Schumacher)

2. Sa element. MJB_177 (121-7), GSC 116706, x71.7, GSC loc. O-104479.
3. Bicostate P element, inner view. MJB_137 (109-22), GSC 116707, x108.3, GSC loc. O-104227.
4. M element, inner view. MJB_136 (109-21), GSC 116708, x87.0, GSC loc. O-104227.

Figures 5–7. *Appalachignathus delicatulus* Bergström, Carnes, Ethington, Votaw and Wigley

5. Sb-Sc element, posterior view. MJB_277 (124-8), GSC 116709, x81.3, GSC loc. O-104498.
6. Pa element. MJB_181 (121-14), GSC 116710, x36.9, GSC loc. O-104489.
7. Sa element, posterior view. MJB_377 (137-15), GSC 116711, x96.2, GSC loc. O-104532.

Figures 8–9. *Belodina boltoni* n. sp.

8. Acostate rastrate element. MJB_386 (137-24), Paratype GSC 116712, x56.6, GSC loc. O-104535.
9. Eobelodiniform element. MJB_131 (109-16), Holotype GSC 116713, x69.1, GSC loc. O-104227.

Figures 10, 11. *Belodina confluens* Sweet

10. Compressiform element. MJB_121 (109-6), GSC 116714, x104.5, GSC loc. O-104227.
11. Grandiform element. MJB_120 (109-5), GSC 116715, x100.0, GSC loc. O-104227.

Figure 12. *Drepanoistodus suberectus* (Branson and Mehl) Homocurvatiform element. MJB_118 (109-3), GSC 116716, x108.0, GSC loc. O-104227.

Figure 13. *Parabelodina denticulata* Sweet. Falciform element. MJB_457 (136-11), GSC 116717, x80.0, GSC loc. O-104479.

Figure 14. *Periodon* aff. *grandis* (Ethington). Sc element, inner view. MJB_385 (137-23), Figured specimen GSC 116718, x165.4, GSC loc. O-104534.

Figures 15, 16. *Phragmodus undatus* Branson and Mehl?

15. M element. MJB_387 (137-25), Figured specimen GSC 116719, x74.2, GSC loc. O-104535.
16. P element. MJB_370 (137-8), Figured specimen GSC 116720, x128.1, GSC loc. O-104531.

Figures 17–19. *Polyplacognathus ramosus* Stauffer

17. Stelliplanate element, upper view. MJB_123 (109-8), GSC 116721, x46.2, GSC loc. O-104227.
18. Pastiniplanate element, upper view. MJB_128 (109-13), GSC 116722, x72.7, GSC loc. O-104227.
19. Stelliplanate element, upper view. MJB_165 (118-20), GSC 116723, x42.9, GSC loc. O-104479.

Figures 20, 21. *Pseudobelodina adentata* Sweet?

20. Nearly erect acostate eobelodiniform (S) element, outer view. MJB_133 (109-18), Figured specimen GSC 116724, x90.7, GSC loc. O-104227.
21. Proclined acostate eobelodiniform (P?) element, inner view. MJB_170 (118-24), Figured specimen GSC 116725, x66.7, GSC loc. O-104479.

Figures 22, 23. *Pseudobelodina? dispansa* (Glenister)

22. Grandiform element. MJB_176 (121-6), GSC 116726, x55.0, GSC loc. O-104479.
24. Grandiform element. MJB_175 (121-5), GSC 116727, x56.3, GSC loc. O-104479.

Figures 24, 25. *Pseudobelodina* aff. *vulgaris* Sweet

24. Three-denticled rastrate (S) element, bowed to unfurrowed side. MJB_365 (137-3), Figured specimen GSC 116728, x86.1, GSC loc. O-104494.
25. Two-denticled rastrate (S) element, bowed to unfurrowed side. MJB_367 (137-5), Figured specimen GSC 116729, x92.9, GSC loc. O-104213.

Figures 26, 27. *Pteracontiodus* sp. A

26. M? element. MJB_449 (136-3), Figured specimen GSC 116730, x54.3, GSC loc. O-104226.
27. Sa element. MJB_178 (121-8), Figured specimen GSC 116731, x46.8, GSC loc. O-104479.

Figure 28. *Taoqupognathus philipi* Savage. Sc5 element. MJB_179 (121-11), GSC 116732, x52.5, GSC loc. O-104479.

Figures 29, 30. *Walliserodus amplissimus* (Serpagli)

29. M element. MJB_464 (136-18), GSC 116733, x52.8, GSC loc. O-104532.
30. Sa element. MJB_275 (124-6), GSC 116734, x75.0, GSC loc. O-104494.

Figures 31, 32. *Milaculum* sp. A

31. Upper view. MJB_458 (136-12), Figured specimen GSC 116735, x88.1, GSC loc. O-104534.
32. MJB_140 (109-25), Figured specimen GSC 116736, x68.4, GSC loc. O-104227.

Figure 33. *Ptiloncodus harrisi* Bordeau. MJB_119 (109-4), GSC 116737, x55.4, GSC loc. O-104227.

Figure 34. Indeterminate hook with base. MJB_460 (136-14), Figured specimen GSC 116738, x93.8, GSC loc. O-104534.

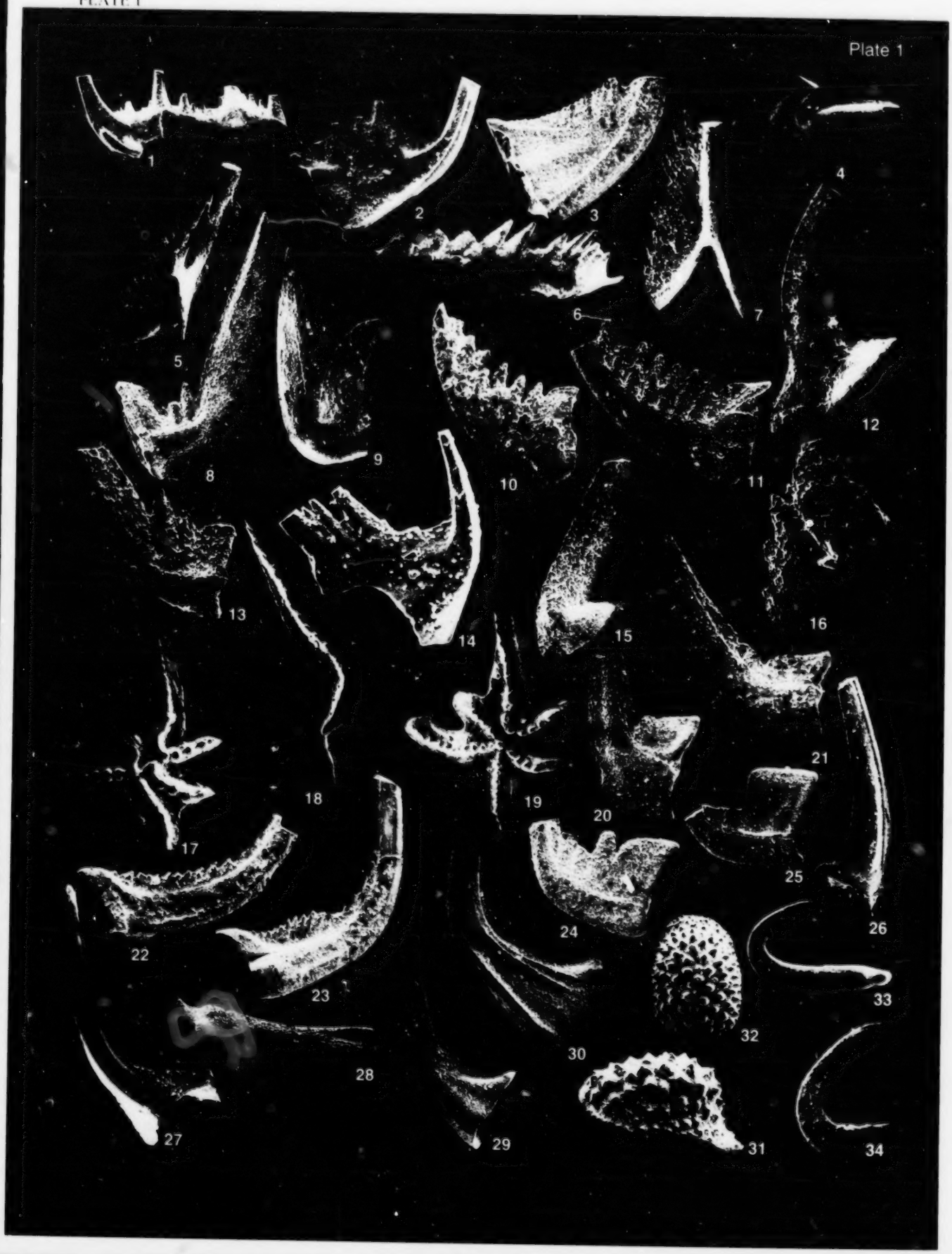
Plate 1
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PLATE 2
Amadjuak Formation, conodonts - I

Figures 1, 2. *Amorphognathus superbus* (Rhodes)
1. Sa element. MJB_349 (140-14), GSC 116739, x128.6, GSC loc. O-104248.
2. M element, posterior view. MJB_350 (140-15), GSC 116740, x97.1, GSC loc. O-104248.

Figure 3. *Aphelognathus politus* (Hinde)
Pb element. MJB_441 (139-21), GSC 116741, x39.2, GSC loc. O-104239.

Figures 4–6. *Belodina arca* Sweet
4. Grandiform element, inner view. MJB_220 (125-17), GSC 116742, x57.4, GSC loc. O-104510.
5. Compressiform element, outer view. MJB_250 (120-2), GSC 116743, x45.0, GSC loc. O-104219.
6. Eobelodiniform element, outer view. MJB_470 (142-2), GSC 116744, x48.4, GSC loc. O-104219.

Figure 7. *Belodina* aff. *arca* Sweet
Grandiform element, inner view. MJB_322 (138-4), Figured specimen GSC 116745, x91.9, GSC loc. O-104536.

Figures 8–10. *Belodina confluens* Sweet
8. Unbowed eobelodiniform element. MJB_299 (127-24), GSC 116746, x50.0, GSC loc. O-104222.
9. Grandiform element with overly developed spatulate cusp, inner view. MJB_265 (123-18), GSC 116747, x43.9, GSC loc. O-104476.
10. Compressiform element, outer view. MJB_252 (120-4), GSC 116748, x52.1, GSC loc. O-104219.

Figures 11–13. *Belodina lillianae* n. sp.
11. Bowed grandiform element, inner view. MJB_251 (120-3), Holotype GSC 116749, x67.1, GSC loc. O-104219.
12. Unbowed compressiform element. MJB_285 (126-1), Paratype GSC 116750, x71.7, GSC loc. O-104248.
13. Eobelodiniform element. MJB_146 (117-13), Paratype GSC 116751, x47.1, GSC loc. O-104521.

Figures 14, 15. *Belodina*? n. sp. B
14. Eobelodiniform element, inner view. MJB_194 (128-11), Figured specimen GSC 116752, x66.7, GSC loc. O-104245.
15. Eobelodiniform element, outer view. MJB_195 (128-12), Figured specimen GSC 116753, x65.3, GSC loc. O-104245.

Figure 16. *Culumbodina occidentalis* Sweet
Proclined element, inner view. MJB_425 (139-5), GSC 116754, x125.0, GSC loc. O-104502.

Figure 17. *Culumbodina penna* Sweet
"L"-shaped element, inner view. MJB_421 (139-1), GSC 116755, x55.0, GSC loc. O-104209.

Figures 18, 19. *Culumbodina* n. sp. X
18. Adenticulate triangular element, inner view. MJB_426 (139-6), Figured specimen GSC 116756, x90.4, GSC loc. O-104241.
19. Denticulate triangular element, outer view. MJB_422 (139-2), Figured specimen GSC 116757, x53.8, GSC loc. O-104500.

Figures 20, 21. *Drepanoistodus suberectus* (Branson and Mehl)
20. Homocurvatiform element. MJB_212 (125-6), GSC 116758, x61.1, GSC loc. O-104510.
21. Oistodiform element. MJB_318 (122-21), GSC 116759, x76.7, GSC loc. O-104219.

Figures 22–26. *Oulodus velicuspus* (Pulse and Sweet)
22. M element. MJB_208 (125-2), GSC 116760, x51.4, GSC loc. O-104510.
23. Sc element, inner view. MJB_207 (125-1), GSC 116761, x75.7, GSC loc. O-104510.
24. Pb element, posterior view. MJB_445 (139-25), GSC 116762, x56.1, GSC loc. O-104216.
25. M element. MJB_151 (117-18), GSC 116763, x42.1, GSC loc. O-104521.
26. Pa element, inner view. MJB_152 (117-19), GSC 116764, x62.1, GSC loc. O-104521.

Figure 27. *Paroistodus*? sp. A Nowlan and McCracken
M element, inner view. MJB_293 (127-15), Figured specimen GSC 116765, x77.3, GSC loc. O-104232.

Figures 28, 29. *Periodon* aff. *grandis* (Ethington)
28. M element, inner view. MJB_300 (127-27), Figured specimen GSC 116766, x77.3, GSC loc. O-104222.
29. Sc element, outer view. MJB_272 (124-2), Figured specimen GSC 116767, x75.0, GSC loc. O-104510.

Figures 30, 31. *Phragmodus undatus* Branson and Mehl
30. Pa element. MJB_297 (127-21), GSC 116768, x53.6, GSC loc. O-104222.
31. Pb element. MJB_296 (127-20), GSC 116769, x70.4, GSC loc. O-104222. See also Plate 3, figures 1, 2.

PLATE 2

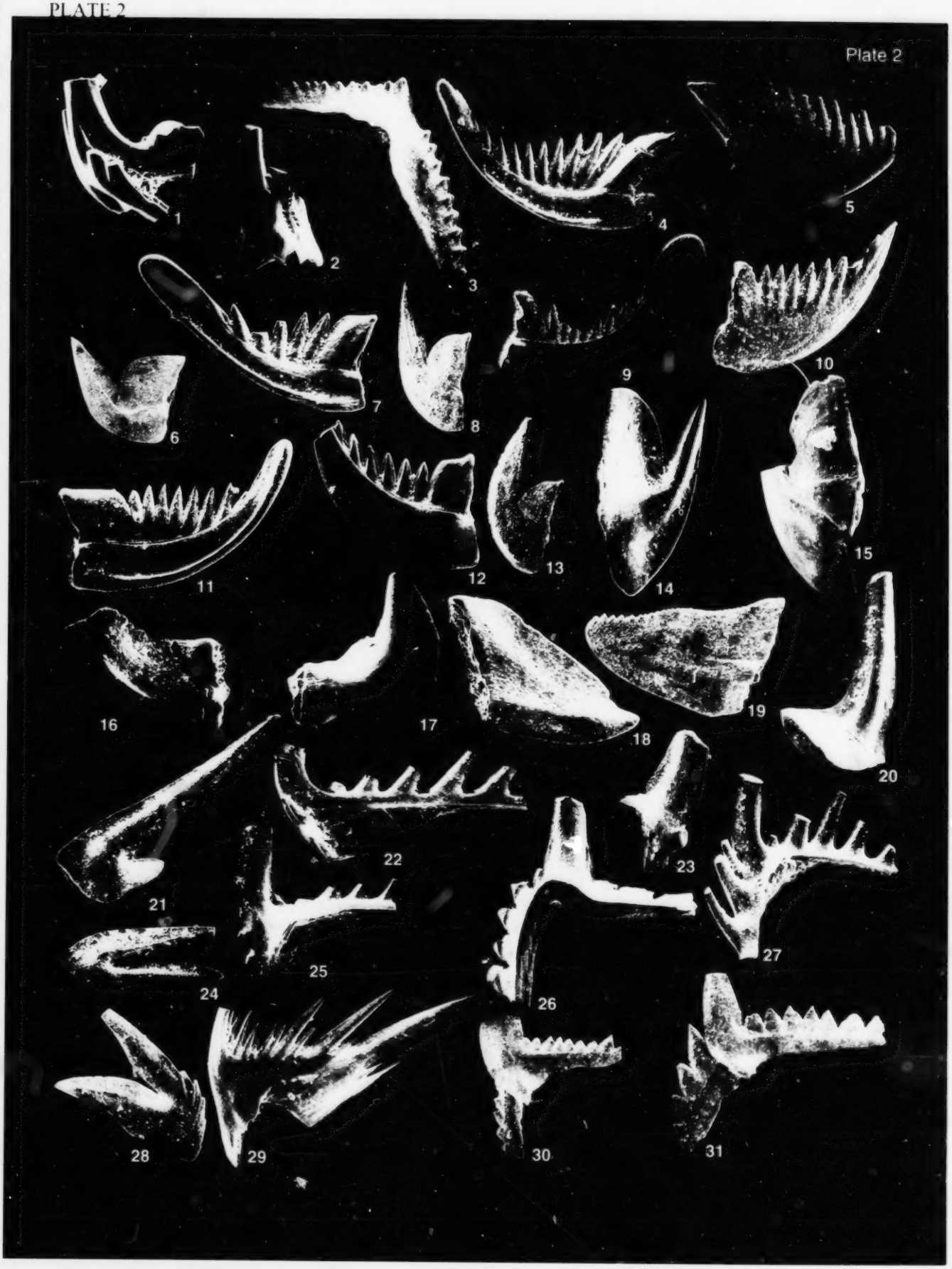
Plate 2
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PLATE 3

Amadjuak Formation, conodonts and incertae sedis - II

Figures 1, 2. *Phragmodus undatus* Branson and Mehl
1. S element. MJB_298 (127-22), GSC 116770, x96.0, GSC loc. O-104222.
2. M element. MJB_198 (128-15), GSC 116771, x67.3, GSC loc. O-104245. See also Plate 2, figures 30, 31.

Figures 3, 4. *Plectodina aculeata* (Stauffer)
3. M element. MJB_398 (141-7), GSC 116772, x58.6, GSC loc. O-104510.
4. Pb element. MJB_223 (125-20), GSC 116773, x56.3, GSC loc. O-104510.

Figures 5–8 *Plectodina tenuis inclinata* (Glenister)
5. Sc element, inner view. MJB_201 (128-18), GSC 116774, x62.9, GSC loc. O-104245.
6. Sb element, posterior view. MJB_206 (128-24), GSC 116775, x86.1, GSC loc. O-104245.
7. M element. MJB_143 (117-6), GSC 116776, x64.6, GSC loc. O-104521.
8. Pb element. MJB_209 (125-3), GSC 116777, x70.3. GSC loc. O-104510.

Figure 9. *Plectodina tenuis tenuis* (Branson and Mehl)
Pb element. MJB_204 (128-21), GSC 116778, x55.7, GSC loc. O-104245.

Figure 10. *Protopanderodus liripipus* Kennedy, Barnes and Uyeno
S element. MJB_258 (120-27), GSC 116779, x60.2, GSC loc. O-104219.

Figures 11, 12. *Pseudobelodina adentata* Sweet?
11. Costate element, inner view. MJB_309 (122-7), Figured specimen GSC 116780, x69.4, GSC loc. O-104219.
12. Costate element, inner view. MJB_193 (128-9), Figured specimen GSC 116781, x105.0, GSC loc. O-104222.

Figure 13. *Pseudobelodina? dispansa* (Glenister)
Grandiform element. MJB_255 (120-19), GSC 116782, x96.0, GSC loc. O-104219.

Figures 14, 15. *Pseudobelodina quadrata* Sweet
14. One-denticled element. MJB_159 (118-8), GSC 116783, x70.0, GSC loc. O-104524.
15. Two-denticled element. MJB_268 (123-21), GSC 116784, x75.8, GSC loc. O-104476.

Figures 16–18. *Staufferella lindstroemi* (Ethington and Schumacher)
16. Symmetrical element, posterior view. MJB_440 (139-20), GSC 116785, x36.8, GSC loc. O-104536.
17. Asymmetrical, long-based element. MJB_439 (139-19), GSC 116786, x52.8, GSC loc. O-104536.
18. Asymmetrical, short-based element. MJB_437 (139-17), GSC 116787, x50.9, GSC loc. O-104536.

Figure 19. *Strachanognathus parvus* Rhodes
MJB_444 (139-24), GSC 116788, x135.3, GSC loc. O-104536.

Figures 20–24. *Walliserodus amplissimus* (Serpagli)
20. Sc element, inner view. MJB_394 (141-3), GSC 116789, x120.6, GSC loc. O-104536.
21. Sb element, inner view. MJB_395 (141-4), GSC 116790, x88.0, GSC loc. O-104536.
22. Sa element. MJB_392 (141-1), GSC 116791, x80.6, GSC loc. O-104536.
23. Sd element. MJB_393 (141-2), GSC 116792, x84.5, GSC loc. O-104536.
24. M element. MJB_396 (141-5), GSC 116793, x90.0, GSC loc. O-104536.

Figures 25–30. *Yaoxianognathus? tunguskaensis* (Moskalenko)
25. Sc element, inner view. MJB_336 (140-1), GSC 116794, x45.7, GSC loc. O-104536.
26. Sa or Sb element, posterior view. MJB_348 (140-13), GSC 116795, x70.0, GSC loc. O-104248.
27. M (falodiform) element, inner view. MJB_343 (140-8), GSC 116796, x43.1, GSC loc. O-104536.
28. Pa (prioniodiniform) element, inner view. MJB_338 (140-3), GSC 116797, x63.9, GSC loc. O-104536.
29. Pc (oulodiform) element, posterior view. MJB_345 (140-10), GSC 116798, x72.2, GSC loc. O-104248.
30. Pb (nathaniform) element, outer view. MJB_339 (140-4), GSC 116799, x52.1, GSC loc. O-104536.

Figure 31. *Milaculum ethinclarki* Müller
Upper view. MJB_316 (122-17), GSC 116800, x74.1, GSC loc. O-104522.

Figure 32. *Milaculum* sp. B
Upper view. MJB_295 (127-19), Figured specimen GSC 116801, x135.7, GSC loc. O-104232.

Figure 33. *Milaculum* sp. D
Upper view. MJB_472 (142-4), Figured specimen GSC 116802, x110.0, GSC loc. O-104536.

Figure 34. *Phosphannulus universalis* Müller, Nogami and Lenz
Upper view. MJB_312 (122-10), GSC 116803, x36.4, GSC loc. O-104219.

Plate 3
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PLATE 4

Akpatok and Foster Bay formations, conodonts and incertae sedis

Figures 1–5. *Amorphognathus duftonus* Rhodes

1. M element, posterior view. MJB_408 (141-17), GSC 116804, x150.0, GSC loc. O-104223.
2. M element, anterolateral view. MJB_406 (141-15), GSC 116805, x166.7, GSC loc. O-104223.
3. Pa element, upper view. MJB_405 (141-14), GSC 116806, x49.0, GSC loc. O-104223.
4. Pa element, upper view. MJB_403 (141-12), GSC 116807, x40.0, GSC loc. O-104223.
5. Pa element, upper view. MJB_402 (141-11), GSC 116808, x39.6, GSC loc. O-104223.

Figures 6–9. *Amorphognathus ordovicicus* Branson and Mehl

6. Sa element. MJB_308 (129-12), GSC 116809, x97.8, GSC loc. O-104223.
7. M element, anterior view. MJB_235 (119-11), GSC 116810, x100.0, GSC loc. O-104225.
8. Pa element, upper view. MJB_231 (119-1), GSC 116811, x41.5, GSC loc. O-104225.
9. Pa element, upper view. MJB_232 (119-3), GSC 116812, x51.1, GSC loc. O-104225.

Figures 10, 11. *Belodina stonei* Sweet

10. Grandiform element, inner view. MJB_237 (119-15), GSC 116813, x34.6, GSC loc. O-104225.
11. Compressiform element, inner view. MJB_240 (119-18), GSC 116814, x66.1, GSC loc. O-104225.

Figures 12–14. *Besselodus borealis* Nowlan and McCracken

12. Distacodiform element. (MJB_360 (140-25), GSC 116815, x121.4, GSC loc. O-104536.
13. Oistodiform (M) element, inner view. MJB_335 (138-16), GSC 116816, x112.5, GSC loc. O-104503.
14. Distacodiform element. MJB_361 (140-26), GSC 116817, x133.4, GSC loc. O-104536.

Figures 15–19. *Coelocerodontus trigonius* Ethington

15. Trigoniform element. MJB_416 (141-25), GSC 116818, x122.0, GSC loc. O-104503.
16. Tetragoniform element, anterolateral view. MJB_473 (142-5), GSC 116819, x135.7, GSC loc. O-104503.
17. Three-costae pyramidal element, posterolateral view. MJB_420 (141-29), GSC 116820, x167.6, GSC loc. O-104503.
18. Four-costae pyramidal element. MJB_419 (141-28), GSC 116821, x135.3, GSC loc. O-104503.
19. Five-costae pyramidal element. MJB_418 (141-27), GSC 116822, x115.4, GSC loc. O-104503.

Figure 20. *Oulodus rohneri* Ethington and Furnish

Pb element, posterior view. MJB_471 (142-3X), GSC 116823, x89.3, GSC loc. O-104502.

Figures 21–23. *Plegagnathus nelsoni* Ethington and Furnish

21. Robustiform (?Sc) element. MJB_246 (119-24), GSC 116824, x53.1, GSC loc. O-104225.
22. Plegagnathiform element, showing concave and furrowed inner face. MJB_248 (119-27), GSC 116825, x57.5, GSC loc. O-104225.
23. Plegagnathiform element, showing concave and unfurrowed inner face. MJB_304 (129-5), GSC 116826, x68.6, GSC loc. O-104223.

Figure 24. *Pseudobelodina? dispansa* (Gleister)

Compressiform element, unbowed inner face. MJB_245 (119-23), GSC 116827, x64.9, GSC loc. O-104225.

Figure 25. *Pseudobelodina inclinata* Sweet

Sb element, showing costate unfurrowed side. MJB_469 (142-1X), GSC 116828, x54.1, GSC loc. O-104502.

Figures 26, 27. *Pseudobelodina vulgaris vulgaris* Sweet

26. Unbowed three-denticled element. MJB_333 (138-17), GSC 116829, x71.0, GSC loc. O-104503.
27. Two-denticled element, showing unfurrowed inner face. MJB_302 (129-3), GSC 116830, x66.7, GSC loc. O-104223.

Figure 28. *Pseudooneotodus* aff. *beckmanni* (Bischoff and Sannemann)

Upper view. MJB_236 (119-12), Figured specimen GSC 116831, x121.4, GSC loc. O-104225.

Figure 29. *Pseudooneotodus mitratus* (Moskalenko)

Upper view. MJB_306 (129-8), GSC 116832, x62.5, GSC loc. O-104223.

Figures 30–32. *Staufferella* n. sp. A

30. Asymmetrical element. MJB_411 (141-20), Figured specimen GSC 116833, x75.0, GSC loc. O-104225.
31. Asymmetrical element, posterior view. MJB_409 (141-18), Figured specimen GSC 116834, x94.2, GSC loc. O-104225.
32. Symmetrical element, posterior view. MJB_412 (141-21), Figured specimen GSC 116835, x153.1, GSC loc. O-104225.

Figures 33, 34. N. Gen. A n. sp. A McCracken

33. MJB_415 (141-24), Figured specimen GSC 116836, x105.0, GSC loc. O-104502.
34. Posterior view. MJB_414 (141-23), Figured specimen GSC 116837, x126.7, GSC loc. O-104225.

Plate 4
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ORDOVICIAN OSTRACODA FROM SOUTHERN BAFFIN ISLAND, NUNAVUT

M.J. Copeland[1]

Ordovician Ostracoda from southern Baffin Island, Nunavut; in Geology and paleontology of the southeast Arctic Platform and southern Baffin Island, Nunavut; Geological Survey of Canada, Bulletin 557, p. 217–236.

Abstract

Fifteen samples from Ordovician rocks of southern Baffin Island were processed for ostracodes; two from the Frobisher Bay Formation and thirteen from the overlying Amadjuak Formation. Numerous other limestone slabs from both formations were examined, but few contained identifiable ostracodes other than *Eoleperditia*? sp. The fauna of the Frobisher Bay Formation bears some resemblance to the faunas of the Lincolnshire and Edinburg formations of Virginia, and that of the Amadjuak Formation to faunas of midcontinental North America. A Blackriveran–Trentonian age appears most probable for these strata, but an age as young as Edenian for the upper part of the Amadjuak Formation may be possible.

Thirty-four genera have been identified, several with more than one species. Four species are discussed in the text, and one of these, *Eurybolbina decora* n. sp., is formally described. The other species mentioned have been described adequately elsewhere.

Résumé

Quinze échantillons de roches ordoviciennes provenant du sud de l'île de Baffin ont été soumises à un traitement afin d'en étudier les ostracodes; deux des échantillons provenaient de la Formation de Frobisher Bay et treize de la Formation d'Amadjuak sus-jacente. Plusieurs autres plaques de calcaire provenant de ces deux formations ont été examinées, mais peu d'entre elles contenaient des ostracodes autres que *Eoleperditia*? sp. La faune de la Formation de Frobisher Bay ressemble quelque peu aux faunes des formations de Lincolnshire et d'Edinburg de la Virginie et celle de la Formation d'Amadjuak ressemble aux faunes de la région médio-continentale de l'Amérique du Nord. L'âge de ces strates se situe probablement au Blackrivérien–Trentonien, mais un âge aussi récent que l'Édénien est possible pour les strates de la partie supérieure de la Formation d'Amadjuak.

Trente-quatre genres d'ostracodes ont été identifiés, dont plusieurs comportent plus d'une espèce. Dans l'article, quatre espèces sont décrites sommairement alors qu'une autre, *Eurybolbina decora* n. sp, l'est de façon formelle. Les autres espèces mentionnées ont été décrites ailleurs.

INTRODUCTION

During the summers of 1988 and 1989, several days were spent by A.D. McCracken and others of the Geological Survey of Canada examining Ordovician strata of southern Baffin Island, Nunavut. Paleontological samples recovered from their investigations reveal the presence of numerous ostracodes, most species of which had been previously recorded in Foxe Basin (Copeland *in* Bolton et al. 1977, p. 77–97) from Melville Peninsula, and southern Baffin Island. At that time, known distribution, both geographic and stratigraphic, of Ordovician ostracode faunas from Baffin Island was largely restricted to strata from Silliman's Fossil Mount (lat. 63°45'00"N; long. 68°56'45"W) at the head of Frobisher Bay. Now, however, collections from Frobisher Bay north and west across Foxe Lowland toward Foxe Basin

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(see Copeland, 1977, fig. 1) are available for study. These collections, when placed within the stratigraphic sequence proposed by Sanford and Grant (1990; this volume), may be of biostratigraphic significance throughout Foxe Lowland.

The history of ostracode studies in Ordovician rocks of the area is recorded in Copeland (1977, p. 77) and need not be repeated here. It is sufficient to say that our knowledge of these faunas is gradually increasing but is by no means complete. Only a few collections from strata of the Frobisher Bay and Amadjuak formations are discussed here, the former containing the distinctive *Gonioceras–Labyrinthites*–sponge megafaunal assemblage, the latter the equally distinctive "Arctic Ordovician Red River" fauna with *Fisherites* and *Maclurites* (Bolton, 1977, and this volume).

ENVIRONMENT OF DEPOSITION, AND COMPOSITION OF THE OSTRACODE FAUNA

Leperditicopid, palaeocopid and podocopid ostracodes occur in both the Frobisher Bay and Amadjuak formations, but leperditicopid valves are less abundant in the shale and marl of the lower part of the Amadjuak Formation. They are more common constituents of the fauna of the carbonate facies that is the predominant lithology of the Frobisher Bay and upper part of the Amadjuak formations. Under the heading 'Paleoecology' Berdan (1984, p. J13) discussed the likely habitat of leperditicopid ostracodes based on the available literature and her personal observations. It appears that a good case may be made that leperditicopids were very shallow-water benthos to the extent that they may have inhabited intertidal to shallow subtidal environments. If this is a valid conclusion (and the present author thinks it is) it would appear that the lower part of the Amadjuak Formation represents a deeper water interval than the underlying and overlying strata. The higher energy environment in which the more shallow-water carbonate was deposited might have caused the separation of the valves of leperditicopids either as moulted carapaces or dead individuals.

Palaeocopid and podocopid ostracodes within this sequence were probably mostly benthic in adaptation, existing on algal mats or burrowing shallowly beneath the mud substrate. Unlike the larger, probably more sluggish and heavier leperditicopids, the palaeocopids and podocopids could not withstand a high energy situation and possibly adapted to a sub-wave-base environment. As a consequence, in the Baffin Island Ordovician collections, leperditicopids are only rarely associated with species of the other ostracode orders.

Leperditicopid ostracodes are found in many of the carbonate samples collected throughout the Ordovician sequence on Baffin Island. The leperditicopids on limestone slabs of both formations are preserved usually as disarticulated valves of *Eoleperditia*? sp. These valves are similar in size and shape to the *Leperditia* sp. from latitude 66.2°N north of Putnam Highland (Gould, 1928, p. 23) which Hussey (1928, p. 74) compared with *Leperditia fabulites* (Conrad) and *Leperditia alta* (Conrad). One specimen from the Frobisher Bay Formation at a small outlier south of Syliva Grinnell Lake (Section 16; GSC loc. O-104770), preserved as a carapace, can be definitely identified as *Eoleperditia* sp. This extremely large specimen (length 24 mm) is more than twice the size of the largest specimens of *E. fabulites* (Conrad) from Manitoulin Island, Ontario and more than three times the size of the largest specimen of that species described by Berdan (1984) from the Tyrone Limestone of Kentucky. However, a specimen of *Leperditia ampla nashvillensis* described by Kirk (1928) from the Catheys Limestone of central Tennessee approaches the present specimen in size and shape but it is a left valve so no evidence of the stop pits is available on which to base a definite generic identification.

Palaeocopid ostracodes of the Frobisher Bay Formation have been recovered only from Section 16 near Sylvia Grinnell Lake (GSC loc. O-104490). Specimens are not numerous but some species are stratigraphically distinctive. Two genera, *Bolbopisthia* and *Physalidopisthia*, included by Guber and Jaanusson (1964) in the Kloedenellidae, are present in the Frobisher Bay and are also known from the lower part of the Edinburg Formation of Virginia (Kraft, 1962). *Bolbopisthia* is also present in the Lexington limestone of central Tennessee (Kirk, 1928) and the Esbataottine Formation of the District of Mackenzie (Copeland, 1974, 1982). These occurrences indicate a Chazyan–Kirkfieldian correlation with the greatest possibility of a Blackriveran age. This sample yielded conodonts that are part of the Frobisher Bay conodont assemblage (McCracken, this volume). Another palaeocopid in the same Frobisher Bay Formation collection (GSC loc. O-104490) is *Monoceratella teres* Teichert. This taxon is present in the Edinburg and Lincolnshire formations of Virginia (Kraft, 1962), and Swain (1962) erected a *Monoceratella teres* Zone for strata of Upper Chazy to Porterfield age in Pennsylvania and eastern New York. Once again a Blackriveran age is considered a distinct possibility.

Palaeocopid and podocopid ostracodes of the Amadjuak Formation are numerous and varied. In particular, the palaeocopids *Tetradella*, *Eurychilina*, *Laccochilina*, *Glymmatobolbina*, *Punctaparchites*, *Eurybolbina*, *Thomasatia* and other genera are prominent components of the fauna. These elements do not provide a definitive age for the Amadjuak Formation but, as stratigraphically the Amadjuak Formation is younger than the Frobisher Bay Formation, a Trentonian (and possibly a post Kirkfieldian) age is probable. Whether an Edenian age may be postulated cannot be deduced solely on the ostracode fauna. Unlike the fauna of the Frobisher Bay, which appears to have elements in common with eastern New York, Virginia, etc. the Amadjuak ostracode fauna apparently bears greater resemblance to faunas of the Middle Ordovician of Lake Timiskaming in northern Ontario, southern Ontario and Minnesota.

List of localities and ostracode fauna identified

Samples were collected by A.D. McCracken; stratigraphic details are provided in McCracken (this volume).

SECTION 7 Stream-cut flowing into small lake at north end of Putnam Highland, lat. 65°19'00"N; long. 73°08'30"W

GSC loc. O-104220, Amadjuak Fm., 1.25–1.35 m
**Steusloffina ulrichi* Teichert

GSC loc. O-104221, Amadjuak Fm., 1.35 m
*ostracode indet.
**?Silenis* sp.
Tetradella sp.
Phelobythocypris cylindrica (Hall)
Steusloffina sp.
Eurychilina sp. cf. *E. subradiata* Ulrich
Laccochilina (*Prochilina*) *granulosa* Copeland
Leperditella sp.

GSC loc. O-104222, Amadjuak Fm., 4.9–5.0 m
**Tetradella buckensis* Guber

SECTION 10 Silliman's Fossil Mount; two of four segments were sampled; measurements correlate between northwest and central mounds, lat. 63°45'00"N; long. 68°56'45"W

GSC loc. O-104231, Amadjuak Fm., Northwest mound, 0.20–0.25 m
**Eurychilina subradiata* Ulrich

GSC loc. O-104229, Amadjuak Fm., Northwest mound, 18 m
**Saccelatia buckensis* Copeland
**Krausella* sp. cf. *K. acuta* (Teichert)
Krausella rawsoni Roy
Eurychilina subradiata Ulrich
"*Aparchites*" *fimbriatus* (Ulrich)
Phelobythocypris cylindrica (Hall)
Laccochilina (*Prochilina*) sp.
Tetradella ulrichi Kay
Eoaquapulex sp.
Leperditella sp.
Ningulella? sp.

GSC loc. O-104232, Amadjuak Fm., Central mound, 18 m
**?Longiscula emaciata* Copeland
**Krausella* sp. cf. *K. acuta* (Teichert)
**Bairdiacypris* sp.
**Glymmatobolbina spinosa* Copeland
**Tubulibairdia*? sp.
**Tetradella buckensis* Guber
**Euprimitia* sp. cf. *E. sanctipauli* (Ulrich)
**Distobolbina warthini* Copeland
**Levisulculus planus* Copeland
**Eoaquapulex* sp. cf. *E. frequens* (Steusloff)
**Aechmina* sp.
**Eurybolbina decora* n. sp.
**Saccelatia buckensis* Copeland
*"*Aparchites*" sp. cf. "*A.*" *fimbriatus* (Ulrich)
**Byrsolopsina centipunctata* Kay
**Punctaparchites rugosus* (Jones)
**Krausella rawsoni* Roy
Phelobythocypris cylindrica (Hall)
Brevidorsa? sp.
Silenis? sp.
Tetradella ulrichi Kay
Laccochilina (*Prochilina*) *granulosa* Copeland
Thomasatia falcicosta Kay
Eurychilina sp.

GSC loc. O-104514, Amadjuak Fm., Northwest mound, 18 m
**Leperditella*? sp.
**Glymmatobolbina spinosa* Copeland
**Krausella* sp. cf. *K. acuta* (Teichert)
**Ningulella*? sp.
*"*Aparchites*" sp. cf. "*A.*" *fimbriatus* (Ulrich)
**Eurychilina subradiata* Ulrich
**Krausella rawsoni* Roy
*"*Aparchites*" sp. cf. "*A.*" *labellosus* (Jones)
**Brevidorsa* sp.
Phelobythocypris cylindrica (Hall)
Eoaquapulex sp. cf. *E. frequens* (Steusloff)

GSC loc. O-104519, Amadjuak Fm., Northwest mound, 26 m
**Laccochilina* (*Prochilina*) *granulosa* Copeland
Eurychilina subradiata Ulrich
Eoaquapulex sp.
Krausella acuta (Teichert)
Phelobythocypris cylindrica (Hall)
Tetradella buckensis Guber
Brevidorsa sp.

GSC loc. O-104520, Amadjuak Fm., Central mound, 31.45 m
"*Aparchites*" sp. cf. "*A.*" *fimbriatus* (Ulrich)
**Eurychilina subradiata* Ulrich
Krausella rawsoni Roy?
Tetradella ellipsilira Kay
Phelobythocypris cylindrica (Hall)
Krausella acuta (Teichert)

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*Specimen(s) figured herein.

SECTION 11A Jordan River outlier, lat. 63°59'15"N; long. 69°10'00"W

GSC loc. O-104541, Amadjuak Fm., 11 m
**Pseudulrichia* sp. cf. *P. byrnesi* (Miller)
Phelobythocypris cylindrica (Hall)
Krausella sp.

SECTION 13 Jordan River outlier, lat. 63°58'30"N; long. 69°13'30"W

GSC loc. O-104241, Amadjuak Fm., 0.45 m
**Tetradella ellipsilira* Kay
**"Aparchites"* sp. cf. *"A." fimbriatus* (Ulrich)
**Punctaparchites rugosus* (Jones)
**Tetradella ulrichi* Kay
**Thomasatia falcicosta* Kay
*ostracode indet.
**Tetradella buckensis* Guber
**Euprimitia* sp. cf. *E. sanctipauli* (Ulrich)
**Phelobythocypris cylindrica* (Hall)
**Distobolbina warthini* Copeland
**Eoaquapulex* sp. cf. *E. frequens* (Steusloff)

SECTION 14 Northwest shore of Amadjuak Lake, lat. 65°14'50"N, long. 71°41'00"W

GSC loc. O-104245, Amadjuak Fm., 1.85–2.0 m
**Laccochilina (Prochilina) granulosa* Copeland
**Pseudulrichia simplex* (Ulrich)
**Eoaquapulex* sp. cf. *E. frequens* (Steusloff)
**Tetradella kayi* Copeland
Tetradella buckensis Guber
Punctaparchites rugosus (Jones)

SECTION 16 Small stream-cut at base of small outlier, immediately south of Sylvia Grinnell Lake, lat. 64°05'45"N; long. 69°26'45"W

GSC loc. O-104490, Frobisher Bay Fm., 2.55 m
**Bolbopisthia* sp.
**Physalidopisthia* sp.
**Monoceratella teres* Teichert
**Bairdiocypris* sp.
Phelobythocypris cylindrica (Hall)
Eurychilina subradiata Ulrich
Tetradella sp.
Leperditella sp.
Silenis? sp.
Steusloffina ulrichi Teichert
Brevidorsa? sp.
Eoleperditia? sp.

GSC loc. O-104770, Frobisher Bay Fm., *Gonioceras* beds, 0–18 m (level unkown)
**Eoleperditia* sp.

SECTION 17 Putnam Highland escarpment, lat. 65°18'00"N, long. 73°01'36" W

GSC loc. O-104473, Amadjuak Fm., 32 m
Steusloffina ulrichi Teichert
Krausella rawsoni Roy
Krausella acuta (Teichert)
Eurychilina sp.
Eoaquapulex sp. cf. *E. frequens* (Steusloff)
Ningulella? sp.

SYSTEMATIC PALEONTOLOGY OF SELECTED SPECIES

All figured specimens are housed in the National Type Collection of Invertebrate and Plant Fossils, Geological Survey of Canada, 601 Booth Street, Ottawa, Ontario K1A 0E8, and are assigned GSC type numbers.

Class Ostracoda Latreille

Order Leperditicopida Scott 1961

Family Leperditiidae Jones 1856

Genus *Eoleperditia* Swartz 1949

Type species. *Cytherina fabulites* Conrad 1843.

Eoleperditia sp.

Plate 5, figures 7–12

Description. One extremely large, postplete carapace is available. It measures 24 mm in length and 16.5 mm in height. The left valve is mostly exfoliated and is buckled inward in the posterodorsal area giving rise to a posterodorsal bulge that could present the impression that the specimen is a true *Leperditia*. The surface of the right valve is very finely punctate. A prominent eye tubercle is preserved on the right valve lying anterodorsally of the large, oval adductor scar. The adductor comprises a hundred or more polygonal to scale-shaped stigmata. There is no chevron scar. Both anterior and posterior of the ventral lappet there is a linear series of three and (?)five pits, respectively, along the free margin of the overlapping right valve. These (?)eight pits are keyhole shaped, the round dorsal part of each pit tapering ventrally to an acuminate tail. These pits are probably reflected internally as pegs or stops against which the edge of the left valve abutted (Berdan, 1984, p. J10, Pl. 1, fig. 1). The valves have no marginal brims.

Remarks. When originally examined, the specimen was considered to be an extremely large *Eoleperditia fabulites* (Conrad, 1843). However, in consultation with J.M. Berdan, U.S. National Museum, some variation appears to exist between the present specimen and *E. fabulites* as described by Berdan (1984) and its synonym *Leperditia canadensis* var. *josephiana* Jones from St. Joseph Island, Lake Huron, Ontario. The major variation appears to be that the present specimen, in lateral view, has a prominent sag ventrally at the point of greatest height of the right valve, whereas *E. fabulites* is smoothly curved from anterior to posterior margins in this area.

Numerous individual valves of *Eoleperditia*? are found on slabs of limestone from many localities between Frobisher Bay and Foxe Basin. All of these specimens are smaller than the specimen described here and appear to more closely represent *E. fabulites* (Conrad). Whereas the present, unusually large, specimen occurs in the Frobisher Bay Formation, other, smaller leperditiids are also present in the overlying Amadjuak Formation.

Type. Figured specimen, GSC 99451; small stream-cut at base of small outlier, immediately south of Sylvia Grinnell Lake, Section 16, Frobisher Bay Formation, *Gonioceras* beds, 0–18 m (level unkown), GSC loc. O-104770.

Order Palaeocopida Henningsmoen 1953

Suborder Kloedenellocopina Scott 1961

Superfamily Kloedenellacea Ulrich and Bassler 1908

Family Lomatopisthiidae Guber and Jaanusson 1964

Genus *Bolbopisthia* Guber and Jaanusson 1964

Type species. *Thomasatia carinata* Kraft, 1962.

Bolbopisthia sp.

Plate 5, figure 1

Description. Valve amplete in lateral view. Hinge long, depressed between dorsal crests of L1 and L3. Cardinal angles obtuse, outer margin of continuous velar flange smoothly rounded. L1 narrow, separated from node-like L2 by a narrow S1. S2 broad, deep, comma shaped. L3 broad, joined to L1–L2 beneath S2, with a posterodorsal depression. Carinal ridge restricted to ventral part of L3, ending posteriorly about mid height of valve as a sharp, posteriorly directed point. Measurements of figured specimen, GSC 99445, length 1.7 mm, height 1.1 mm.

Remarks. Only one specimen was obtained during the present study. It is, therefore, unknown as to whether the specimen is a tecnomorph or heteromorph. From the size of the specimen it is considered to be an adult individual.

This species differs from *B. carinata* (Kraft) in having the carinal ridge restricted to L3, apparently having a single dorsal depression on L3 rather than a series of small depressions and having the dorsal margins of L1 and L3 crested rather than smoothly curved as on *B. carinata*.

A specimen of *Bolbopisthia*? sp. was illustrated by Copeland (1977, Pl. 5, fig. 8) from the Amadjuak Formation at Silliman's Fossil Mount. That specimen has a more pronounced, bulbous L3 lacking a dorsal depression, and the carinal structure is long (more similar to that of *B. carinata*) but does not end in a sharp point.

Type. Figured specimen, GSC 99445; small stream-cut at base of small outlier, immediately south of Sylvia Grinnell Lake, Section 16, Frobisher Bay Formation, 2.55 m, GSC loc. O-104490.

Genus *Physalidopisthia* Guber and Jaanusson 1964

Type species. *Thomasatia marginovelata* Kraft, 1962.

Physalidopisthia sp.

Plate 5, figure 4

Description. Valve essentially unisulcate, with L2 appressed to posterior side of L1. L1 dorsally crested above hinge. L2 a low, flat node. S2 relatively deep, broad, comma-shaped. L3 broad, elevated ventrally, less elevated in dorsal part, dorsally crested above hinge. Velum entire, narrow, sharply set off from lateral surface of the valve. Measurements of figured specimen, GSC 99448, length 1.8 mm, height 1.2 mm.

Remarks. Only one specimen was obtained during the present study. From the dorsal configuration of L3 it would appear that this specimen is a tecnomorphic valve. This species is somewhat similar to *P. marginovelata* (Kraft) but bears a dorsal crest on L1 and the velar structure is narrower.

Type. Figured specimen, GSC 99448; Frobisher Bay Formation, GSC loc. O-104490.

Suborder Beyrichicopina Scott 1961

Superfamily Hollinacea Swartz 1936

Family Hollinidae Swartz 1936

Genus *Eurybolbina* Copeland 1982

Type species. *Eurybolbina krafti* Copeland, 1982.

Eurybolbina decora n. sp.

Plate 2, figures 3, 6, 9, 10, 12, 13

Description. Valves amplete, hingeline long, straight. Cardinal angles about 90°, posterior cardinal angle with a posterodorsally directed projection. Unisulcate, L2 appressed to posterior margin of L1. L2 a rounded node slightly above mid height of valve. S2 somewhat pit-like posterior of L2, shallowing dorsally to hingeline. L3 broad. Velar structure narrow, extending from anterior cardinal angle almost to mid posterior, well removed from the marginal ridge on each valve.

Surface, except for ventral portion of S2, covered with reticulae that vary from faintly polygonal to scalelike. Area between velum and marginal ridge also with the same reticular pattern. Valve area between marginal ridge and valve closure sometimes with faint vertical ridges. Measurements of holotype, GSC 95835, length 1.0 mm, height 0.6 mm.

Remarks. It would appear that only tecnomorphic valves of this species have been recovered. The velar structure remains equally narrow throughout its length, is abruptly terminated posteriorly and does not extend as a spine as on *E. bispinata* (Harris). The surface of the valves of *E. decora* is reticulate in a fashion not reminiscent of any other species of the genus.

Types. Holotype, GSC 95835, paratypes, GSC 95833, 95834, 95836; Silliman's Fossil Mount, Section 10, Amadjuak Formation, 18 m, GSC loc. O-104232.

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PLATE 1

Figures 1–3. *Tetradella ellipsilira* Kay, 1934

1. Lateral view of right valve, heteromorph, x60, GSC loc. O-104241, hypotype, GSC 95814.
2. Lateral view of right valve, tecnomorph, x70, GSC loc. O-104241, hypotype, GSC 95815.
3. Lateral view of left valve, tecnomorph, x70, GSC loc. O-104241, hypotype, GSC 95816.

Figures 4, 8. *Tetradella kayi* Copeland, 1965

4. Lateral view of left valve, tecnomorph, x70, GSC loc. O-104245, hypotype, GSC 95817.
8. Lateral view of right valve, tecnomorph, x70, GSC loc. O-104245, hypotype, GSC 95818.

Figures 5, 7, 9, 11. *Tetradella ulrichi* Kay, 1934

5. Lateral view of left valve, tecnomorph, x80, GSC loc. O-104241, hypotype, GSC 95819.
7. Lateral view of right valve, heteromorph, x70, GSC loc. O-104241, hypotype, GSC 95820.
9. Lateral view of left valve, heteromorph, x80, GSC loc. O-104241, hypotype, GSC 95821.
11. Ventral view of left valve, heteromorph, x70, GSC loc. O-104241, hypotype, GSC 95822.

Figures 6, 10, 12, 13. *Tetradella buckensis* Guber, 1971

6. Lateral view of right valve, heteromorph, x50, GSC loc. O-104222, hypotype GSC 95823.
10. Lateral view of right valve, tecnomorph, x80, GSC loc. O-104241, hypotype, GSC 95824.
12. Lateral view of right valve, tecnomorph, x80, GSC loc. O-104232, hypotype, GSC 95825.
13. Lateral view of left valve, heteromorph, x60, GSC loc. O-104241, hypotype, GSC 95826.

Figures 14, 15. *Distobolbina warthini* Copeland, 1977

14. Lateral view of left valve, tecnomorph, x100, GSC loc. O-104241, hypotype, GSC 95827.
15. Ventral view of carapace, heteromorph, x100, GSC loc. O-104241, hypotype, GSC 95828.

Plate 1

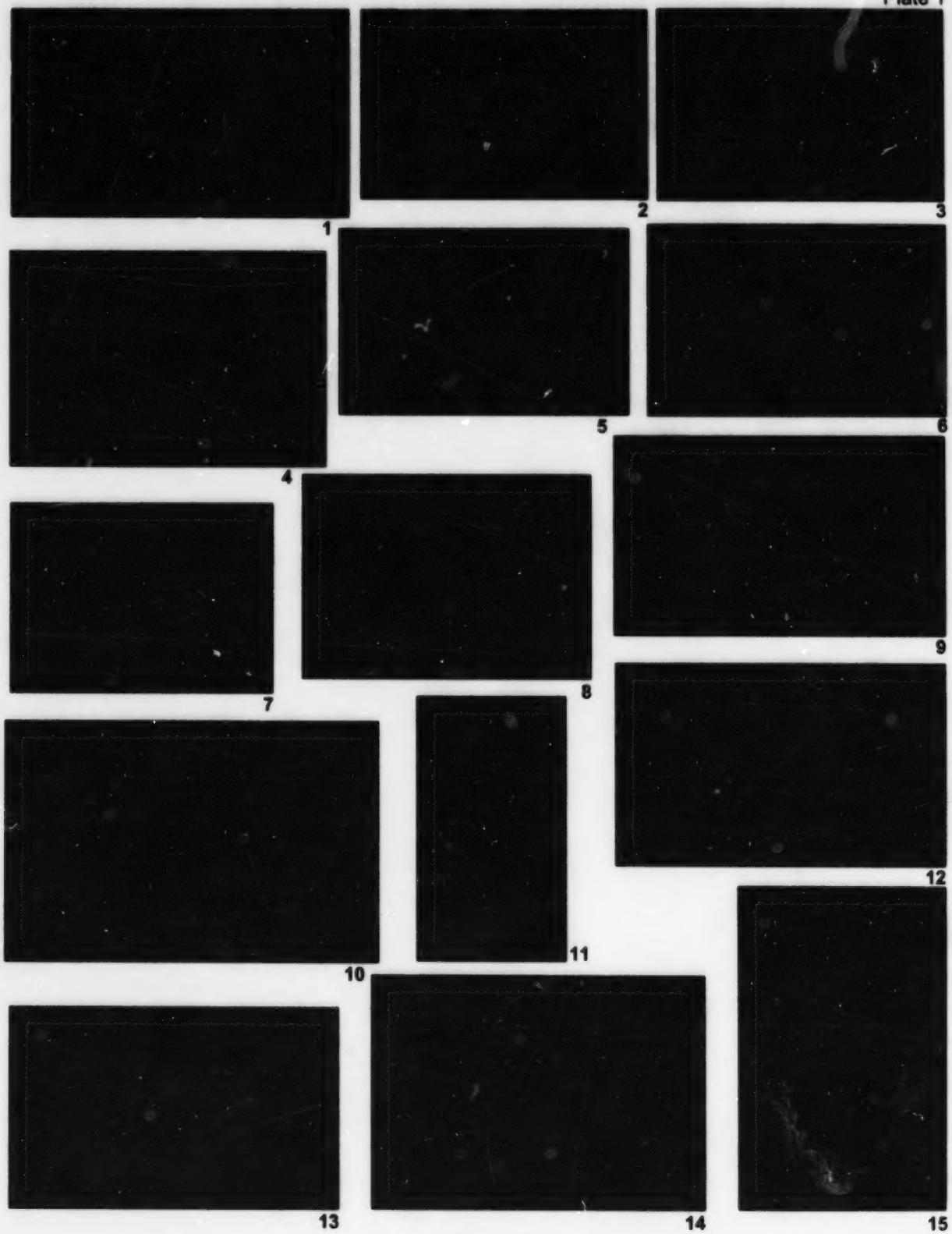

PLATE 2

Figure 1. *Distobolbina warthini* Copeland, 1977. Lateral view of right valve, tecnomorph, x120, GSC loc. O-104232, hypotype, GSC 95829.

Figures 2, 4, 5. *Laccochilina* (*Prochilina*) *granulosa* Copeland, 1965

2. Ventral view, carapace, x39, GSC loc. O-104245, hypotype, GSC 95830.

4. Lateral view of right valve, x50, GSC loc. O-104245, hypotype, GSC 95831.

5. Lateral view of right valve, x50, GSC loc. O-104245, hypotype, GSC 95832.

Figures 3, 6, 9, 10, 12, 13. *Eurybolbina decora* n. sp.

3. Lateral view of right valve, carapace, x80, GSC loc. O-104232, paratype, GSC 95833.

6, 13. Lateral views of left valve, carapace, x100 and x300, GSC loc. O-104232, paratype, GSC 95834.

9, 10. Ventral views of a carapace x80 and x250, GSC loc. O-104232, holotype, GSC 95835.

12. Lateral view of left valve, carapace x80, GSC loc. O-104232, paratype, GSC 95836.

Figure 7. "*Aparchites*" sp. cf. "*A.*" *fimbriatus* (Ulrich, 1892). Lateral view of left valve, carapace, x36, GSC loc. O-104241, figured specimen, GSC 95837.

Figures 8, 11. *Thomasatia falcicosta* Kay, 1934

8. Lateral view of left valve, x45, GSC loc. O-104241, hypotype, GSC 95838.

11. Lateral view of left valve, x45, GSC loc. O-104241, hypotype, GSC 95839.

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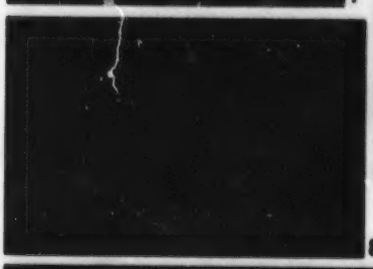
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PLATE 3

Figures 1, 2. *Byrsolopsina centipunctata* Kay, 1940

1. Lateral view of right valve, x100, GSC loc. O-104232, hypotype, GSC 95840.
2. Lateral view of right valve, x100, GSC loc. O-104232, hypotype, GSC 95841.

Figures 3, 12. *Pseudulrichia simplex* (Ulrich, 1894)

3. Lateral view of right valve, x70, GSC loc. O-104245, hypotype, GSC 95842.
12. Lateral view of right valve, x70, GSC loc. O-104245, hypotype, GSC 95843.

Figures 4, 10. *Euprimitia* sp. cf. *E. sanctipauli* (Ulrich, 1894)

4. Lateral view of left valve, x80, GSC loc. O-104241, figured specimen, GSC 95844.
10. Lateral view of right valve, carapace, x80, GSC loc. O-104232, figured specimen, GSC 95845.

Figures 5, 13, 15. *Eoaquapulex* sp. cf. *E. frequens* (Steusloff, 1894)

5 Lateral view of right valve, carapace, heteromorph, x30, GSC loc. O-104241, figured specimen, GSC 95846.
13. Lateral view of right valve, carapace, x40, GSC loc. O-104232, figured specimen, GSC 95847.
15. Lateral view of left valve, carapace, tecnomorph, x60, GSC loc. O-104245, figured specimen, GSC 95848.

Figures 6, 14. *Saccelatia buckensis* Copeland, 1965

6. Lateral view of left valve, carapace, x80, GSC loc. O-104229, hypotype, GSC 95849.
14. Lateral view of right valve, carapace, x70, GSC loc. O-104232, hypotype, GSC 95850.

Figures 7–9. *Punctaparchites rugosus* (Jones, 1858)

7. Lateral view of right valve, carapace, x70, GSC loc. O-104241, hypotype, GSC 95851.
8. Lateral view of right valve, x70, GSC loc. O-104241, hypotype, GSC 95852.
9. Lateral view of right valve, x50, GSC loc. O-104232, hypotype, GSC 95853.

Figure 11. *Levisulculus planus* Copeland, 1965. Lateral view of left valve, x100, GSC loc. O-104232, hypotype, GSC 95854.

Figure 16. *Steusloffina ulrichi* Teichert, 1937. Lateral view of left valve, x38, GSC loc. O-104220, hypotype, GSC 95855.

Figure 17. *Aechmina* sp. Ventral view, carapace, x45, GSC loc. O-104232, figured specimen, GSC 95856.

Figure 18. Ostracode indet. Lateral view of right? valve, x45, GSC loc. O-104241, figured specimen, GSC 95857.

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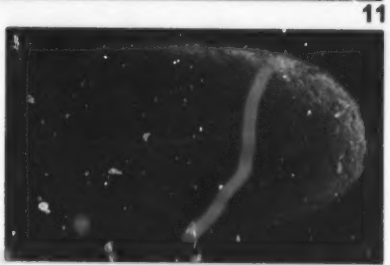
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PLATE 4

Figure 1. "*Aparchites*" sp. cf. "*A.*" *fimbriatus* (Ulrich, 1892). Lateral view of left valve, carapace, x28, GSC loc. O-104232, figured specimen, GSC 95858.

Figure 2. *Tubulibairdia*? sp. Lateral view of right valve, carapace, x73, GSC loc. O-104232, figured specimen, GSC 95859.

Figure 3. *Saccelatia buckensis* Copeland, 1965. Lateral view of left valve, carapace, x70, GSC loc. O-104232, hypotype, GSC 95860.

Figure 4. *Eurychilina subradiata* Ulrich, 1890. Lateral view of left valve, x18, GSC loc. O-104231, hypotype, GSC 95861.

Figures 5, 6. *Glymmatobolbina spinosa* Copeland, 1977

5. Lateral view of right valve, carapace, x 26, GSC loc. O-104232, hypotype, GSC 95862.

6. Lateral view of right valve, x27, GSC loc. O-104232, hypotype, GSC 95863.

Figure 7. *Krausella rawsoni* Roy, 1941. Dorsal view of carapace, x60, GSC loc. O-104232, hypotype, GSC 95864.

Figures 8, 9, 11, 12. *Krausella* sp. cf. *K. acuta* (Teichert, 1937)

8. Lateral view of right valve, carapace, x20, GSC loc. O-104232, figured specimen, GSC 95865.

9. Lateral view of right valve, carapace, x30, GSC loc. O-104232, figured specimen, GSC 95866.

11. Ventral view, carapace, x 27, GSC loc. O-104229, figured specimen, GSC 95867.

2. Dorsal view, carapace, x25, GSC loc. O-104229, figured specimen, GSC 95868.

Figure 10. Ostracode indet. Lateral view of right? valve, carapace, x50, GSC loc. O-104221, figured specimen, GSC 95869.

Figures 13, 15. *Phelobythocypris cylindrica* (Hall, 1871)

13. Lateral view of right valve, carapace, x33, GSC loc. O-104241, hypotype, GSC 95870.

15. Lateral view of right valve, carapace, x26, GSC loc. O-104241, hypotype, GSC 95871.

Figure 14. *Bairdiacypris* sp. Lateral view of right valve, carapace, x40, GSC loc. O-104232, figured specimen, GSC 95872.

Figure 16. ?*Longiscula emaciata* Copeland, 1965. Lateral view of left valve, carapace, x60, GSC loc. O-104232, figured specimen, GSC 95873.

Figure 17. ?*Silenis* sp. Lateral view of left valve, carapace, x42, GSC loc. O-104221, figured specimen, GSC 95874.

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PLATE 5

Figure 1. *Bolbopisthia* sp. Lateral view of left valve, tecnomorph, x30, GSC loc. O-104490, figured specimen GSC 99445.

Figures 2, 3. *Pseudulrichia* sp. cf. *P. byrnesi* (Miller, 1874)

2. Lateral view of right valve, x50, GSC loc. O-104541, figured specimen, GSC 99446.

3. Lateral view of left valve, x50, GSC loc. O-104541, figured specimen, GSC 99447.

Figure 4. *Physalidopisthia* sp. Lateral view of right valve, x33, GSC loc. O-104490, figured specimen, GSC 99448.

Figure 5. *Monoceratella teres* Teichert, 1937. Lateral view of left valve, x33, GSC loc. O-104490, hypotype, GSC 99449.

Figure 6. *Eurychilina subradiata* Ulrich, 1890. Lateral view of right valve, x20, GSC loc. O-104520, hypotype, GSC 99450.

Figures 7–12. *Eoleperditia* sp. GSC loc. O-104770, figured specimen, GSC 99451.

7, 8. Right and left lateral views of carapace, x2.

9, 10. Ventral and dorsal views of carapace, x2.

11. Anterior view of right valve, x6. Note position of eye tubercle and anteroventral stop pits.

12. Anterior view of left valve, x6. Note stigmata of adductorial muscle scar and ventral lappet overlap of right valve.

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PLATE 6

Figure 1. *Laccochilina* (*Prochilina*) *granulosa* Copeland, 1965. Right lateral view of a carapace, x30, GSC loc. O-104519, hypotype, GSC 99533.

Figure 2. *Leperditella*? sp. Left lateral view of a carapace, x20, GSC loc. O-104514, figured specimen, GSC 99534.

Figure 3. *Glymmatobolbina spinosa* Copeland, 1977. Left lateral view of a carapace, x20, GSC loc. O-104514, hypotype, GSC 99535.

Figure 4. *Bairdiocypris* sp. Right lateral view of a carapace, x20, GSC loc. O-104490, figured specimen, GSC 99536.

Figure 5. *Monoceratella teres* Teichert, 1937. Ventral view of a carapace, x30, GSC loc. O-104490, hypotype, GSC 99537.

Figures 6–9. *Krausella* sp. cf. *K. acuta* (Teichert, 1937)

6. Right lateral view of a carapace, x27, GSC loc. O-104514, figured specimen, GSC 99538.

7. Right lateral view of a carapace, x20, GSC loc. O-104514, figured specimen, GSC 99539.

8. Right lateral view of a carapace, x27, GSC loc. O-104514, figured specimen, GSC 99540.

9. Left lateral view of a carapace, x27, GSC loc. O-104514, figured specimen, GSC 99541.

Figure 10. *Ningulella*? sp. Left lateral view of a carapace, x40, GSC loc. O-104514, figured specimen, GSC 99542.

Figures 11, 14. "*Aparchites*" sp. cf. "*A.*" *fimbriatus* (Ulrich, 1892)

11. Left lateral view of a carapace, x30, GSC loc. O-104514, figured specimen, GSC 99543.

14. Left lateral view of a carapace, x20, GSC loc. O-104514, figured specimen, GSC 99546.

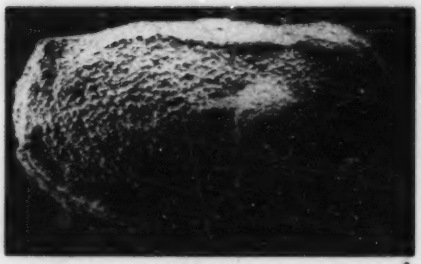
Figure 12. *Eurychilina subradiata* Ulrich, 1890. Left lateral view of a carapace, x21, GSC loc. O-104514, hypotype, GSC 99544.

Figure 13. *Krausella rawsoni* Roy, 1941. Left lateral view of a carapace, x25, GSC loc. O-104514, hypotype, GSC 99545.

Figure 15. "*Aparchites*" sp. cf. "*A.*" *labellosus* (Jones, 1891). Right lateral view of a carapace, x20, GSC loc. O-104514, figured specimen, GSC 99547.

Figure 16. *Brevidorsa* sp. Left lateral view of a carapace, x25, GSC loc. O-104514, figured specimen, GSC 99548.

Figure 17. *Leperditella*? sp. Left lateral view of a carapace, x25, GSC loc. O-104514, figured specimen, GSC 99549.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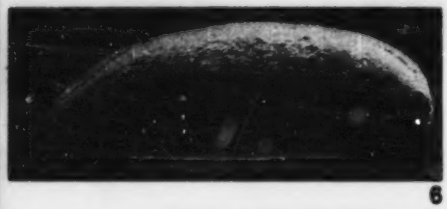
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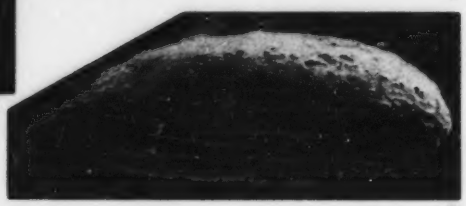
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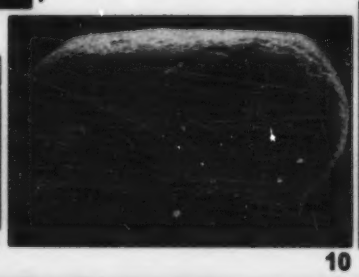
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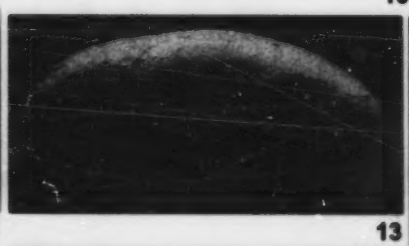
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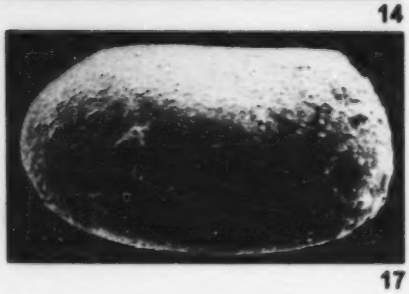
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LATE MIDDLE–EARLY LATE ORDOVICIAN GRAPTOLITES FROM THE BASE OF THE AMADJUAK FORMATION, SOUTHERN BAFFIN ISLAND, NUNAVUT

J.F.V. Riva[1]

Late Middle–early Late Ordovician graptolites from the base of the Amadjuak Formation, southern Baffin Island, Nunavut; ***in*** *Geology and paleontology of the southeast Arctic Platform and southern Baffin Island, Nunavut; Geological Survey of Canada, Bulletin 557, p. 237–240.*

Abstract

The graptolites *Climacograptus* (*Diplacanthograptus*) *spiniferus* Ruedemann and *Amplexograptus praetypicalis* Riva have been identified from the base of the Amadjuak Formation in southern Baffin Island. These two species date the base of the formation as latest Mohawkian–early Edenian (lower *Climacograptus spiniferus* Zone), much older than the base of the trangressive Ordovician succession deposited on the Laurentian Shield in Late Ordovician time (uppermost *Climacograptus pygmaeus* Zone = Late Maysvillian) after the emplacement of the Taconic allochthon.

Résumé

Les Graptolithes *Climacograptus* (*Diplacanthograptus*) *spiniferus* Ruedemann et *Amplexograptus praetypicalis* Riva ont été identifiés dans la partie basale de la Formation de Amadjuak dans le sud de l'Ile de Baffin. Ces Graptolithes datent la base de la formation comme Mohawkien supérieur–Edénien précoce (partie inférieure de la Zone à *Climacograptus spiniferus*), la rendant ainsi beaucoup plus ancienne que la base de la couverture ordovicienne trangressive deposée sur le Bouclier Laurentien dans l'Ordovicien tardif (partie supérieure de la Zone à *Climacograptus pygmaeus* = Maysvillien tardif), après la mise en place de l'allochtone taconique.

GRAPTOLITES

Graptolites occur as scattered, broken, current-transported fragments in the dark brown, light grey weathering, micaceous shale unit near the base of the Ordovician Amadjuak Formation at the Jordan River outlier in southern Baffin Island (section 11A of McCracken, this volume). Lithologically this unit resembles the Utica Shale of New York and southern Quebec. The graptolites are associated with numerous brachiopods such as *Paucicrura rogata* (Sardeson), the trilobites *Triarthrus* (*Triarthrus*) *eatoni* (Hall), *Pseudogygites arcticus* Ludvigsen, gastropods, crinoidal ossicles, etc. (Bolton, this volume). Conodonts below this level, in strata believed to be equivalent to similar strata at Amadjuak Lake, contain *Amorphognathus superbus* Rhodes, which indicates an upper Shermanian–lower Maysvillian age (McCracken, this volume). Two graptolite species have been identified from 4.5 m to 8 m above the base of the section in the Jordan River outlier (GSC loc. O-104537–O-104539):

1. *Climacograptus* (*Diplacanthograptus*) *spiniferus* Ruedemann (GSC 115450–115452, Fig. 1a-c) is common, but occurs in scattered fragments and is poorly preserved. The proximal end is missing in most specimens, but it was recovered by the removal of matrix in three specimens. These show the two basal spines diagnostic of the species, one clearly being the virgella grown outward under the sicular aperture to counterbalance the mesial spine of th1[1].

One weathered specimen (Fig. 1a) also shows two membranes, or vanes, grown concentrically around the basal spines and reaching up almost to the aperture of the first pair of thecae. These membranes, though common in the older

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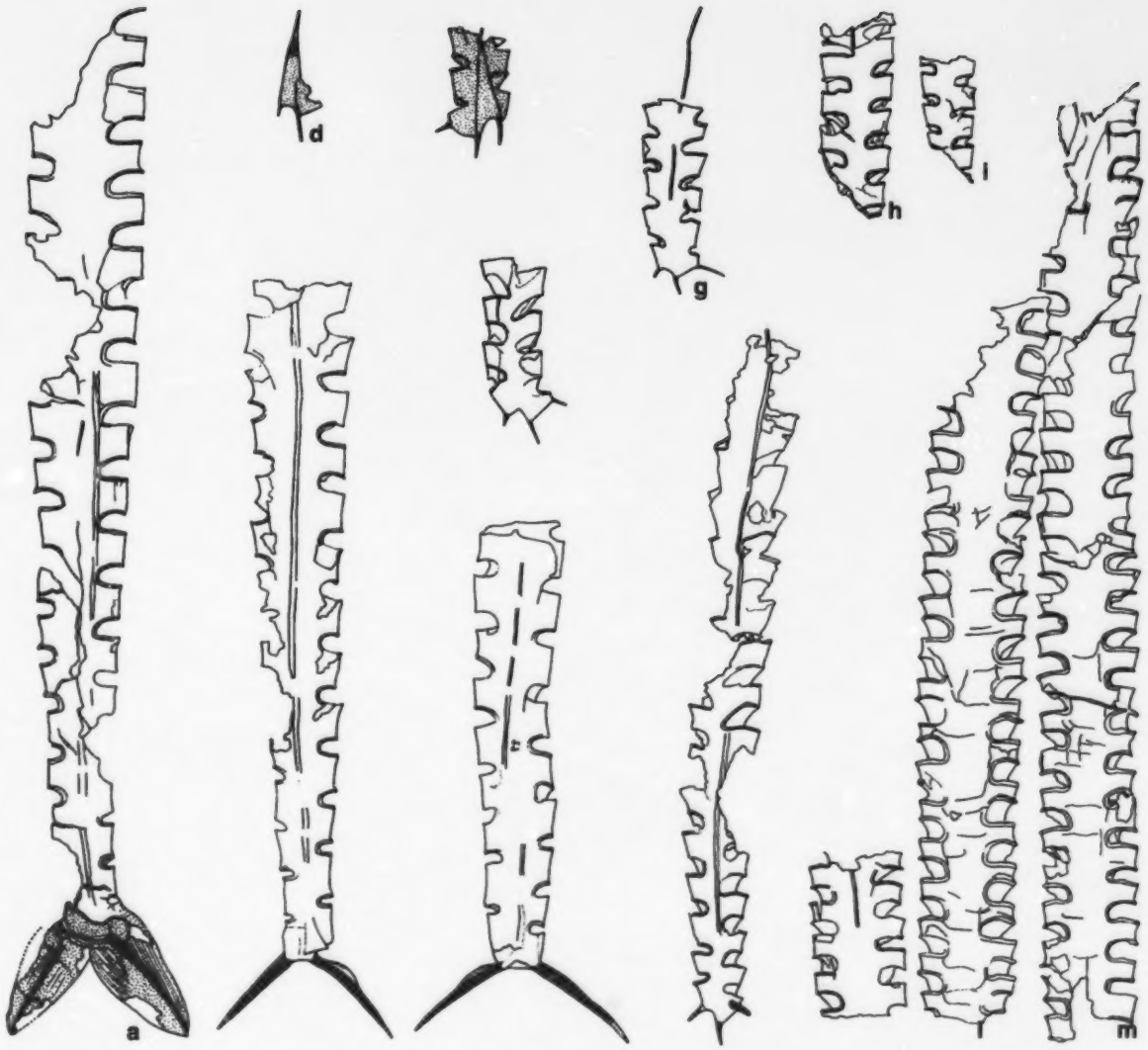

Figure 1. *Late Middle–early Late Ordovician graptolites from the lower shale unit of the Amadjuak Formation, Baffin Island. All figured specimens are hypotypes and are assigned GSC type numbers. They are housed in the National Type Collection of Invertebrate and Plant Fossils, Geological Survey of Canada, 601 Booth Street, Ottawa, Ontario K1A 0E8.*

1a–c, Climacograptus (Diplacanthograptus) spiniferus *Ruedemann, GSC. loc. O-104537, 4.5 m to 8 m above the base of the section;* ***a****, specimen with a large membrane enveloping the basal spines;* ***b****,* ***c****, with only marginal membranes on spines;* ***a****: GSC 115450,* ***b****: GSC 115452,* ***c****: GSC 115451; (all x10).*

1d–f, k–m, Amplexograptus praetypicalis *Riva, GSC loc. O-104538, 4.5 m above the base of the section;* ***d–f****, sicula and growth stages with mesial spine on th1[1], virgella and antivirgellar spines;* ***k–m****, distal portions of current-transported mature rhabdosomes;* ***d****: GSC 115458,* ***e****: GSC 115459,* ***f****: GSC 115460,* ***k****: GSC 115462,* ***l****: GSC 115463,* ***m****: GSC 115464;* ***d–f*** *(x10);* ***k–m*** *(x7).*

1g–j, Amplexograptus praetypicalis *Riva, GSC loc. O-104539, 8 m above the base of the section;* ***g****, growth stage;* ***h****,* ***l****, examples of remnants of mature specimens common in this collection;* ***j****, current-transported and twisted juvenile rhabdosome;* ***g****: GSC 115453,* ***h****: GSC 115456,* ***l****: GSC 115457,* ***j****: GSC 115454;* ***g****,* ***j****: (x10);* ***h****,* ***l*** *(x7).*

Climacograptus bicornis (Hall) (Riva, 1976, text-fig. 5–9), are normally absent, or just incipient, in *C.* (*D.*) *spiniferus*. Similar membranes have been recognized in specimens of the species from the basal Utica Shale at Portneuf, Quebec and the Lozo-Joseph 2 core from southern Quebec (Riva, 1969, fig. 3n–o; 1974, text-fig. 3c–d), where the species is associated with graptolites characteristic of the lower *Climacograptus spiniferus* Zone.

2. *Amplexograptus praetypicalis* Riva 1987 (GSC 115453–115464; Fig. 1d–m) occurs as scattered, current-strewn proximal ends and lined-up distal fragments. Groups of distal fragments are common in collections from the 4.5 m level (GSC loc. O-104538). The characteristic morphology of this species is clearly shown by the few proximal ends preserved (Fig. 1d–f, g, j), which display the three diagnostic types of proximal spines: the virgella, the two antivirgellar spines and the mesial spine on th1[1]. The distal ends (Fig. 1h, i and k–m) also show the thecal apertures provided with the distinctive apertural lappets.

AGE AND CORRELATION

Climacograptus spiniferus and *A. praetypicalis* are the characteristic and diagnostic graptolites of the lower half of the *Climacograptus spiniferus* Zone of eastern North America (Riva, 1974), which Bergström and Mitchell (1994, p. 7, fig. 4) correlated with the basal Cobourgian of New York and Quebec, or the uppermost Mohawkian–basal Edenian of the Cincinnati region. The lower half of the zone is clearly indicated by the abundance of *A. praetypicalis*, to which it is restricted. In the upper half of the zone, *A. praetypicalis* is replaced by *Climacograptus* (*Geniculograptus*) *typicalis* Hall, which, in turn, ranges up to the top of the succeeding *Climacograptus pygmaeus* Zone (late Maysvillian).

In eastern Canada this graptolite faunule correlates precisely with the lower *C. spiniferus* Zone of the lower Utica Shale of the upper Middle–lower Upper Ordovician sequence in the Quebec City area, especially the Neuville–Pont Rouge–Montmorency Falls area, where the basal Utica is well exposed, succeeding without depositional break the limestones of the Trenton Group (Riva, 1969, p. 527–529, Fig. 7a). This is the only place in eastern Canada where the conformable Trenton–Utica contact can be observed with ease; elsewhere, it is commonly replaced by a diachronous unconformity that extends westward to Ontario, Manitoulin Island (Riva *in* Clark, 1972, p. 51–54, fig. 16–17), and northern Michigan (Goldman and Bergström, 1995), and northward to the Lake St. John area on the Precambrian Shield (Riva, 1969, p. 450–543, fig. 14).

REMARKS

In a recent revision of the Australasian graptolite zonal sequence, VandenBerg and Cooper (1992, p. 48, fig. 9o) stated that the Victorian species *Diplograptus tardus* T.S. Hall 1908 is identical to and, consequently, the senior synonym of *A. praetypicalis*. A revision of the type material of *D. tardus* carried out while this study was in progress has shown unequivocally that any similarity between *D. tardus* and *A. praetypicalis* is only at the generic level. The type material of *D. tardus* consists of two collections from two separate localities: one containing specimens identical to the well-known *Amplexograptus perexcavatus* Lapworth from the *Nemagraptus gracilis* Zone, and the other the typical *D. tardus*. The type material of *D. tardus* consists of specimens with extremely long and robust proximal spines (including the virgella) that contrast markedly with the short and weak proximal spines of *A. praetypicalis*. Moreover, the rhabdosome of *A. tardus* is short and robust and wider proximally than in *A. praetypicalis*. The few associated graptolites also indicate an older zonal level, possibly the *N. gracilis* Zone. The thecal apertures have lappets, but this morphological trait is common to all species of *Amplexograptus*.

Graptolite faunas of other brown shale sequences

At first sight, the dark brown, micaceous shale, rich in shelly fossils, near the base of the Amadjuak Formation on southern Baffin Island, could easily be mistaken for the lower dark brown shale member of the Whitby Formation that outcrops extensively in southern Ontario along the shore of Georgian Bay, where it overlies with apparent conformity limestones of the Trenton Group (M. Melchin, pers. comm., 1998). However, the graptolites from the lower member of the Whitby Formation (from unpublished data extracted from seventeen cores in Ontario and Manitoulin Island provided by R. Ludvigsen in 1983 and collections made by Riva in 1979) all belong to the uppermost *Climacograptus pygmaeus* Zone (late Maysvillian). They consist of one or more of the following species: *Climacograptus* (*Geniculograptus*) *pygmaeus* Ruedemann, C. (*G.*) *typicalis*, *C.* (*Geniculograptus*) *typicalis magnificus* Twenhofel, *C.* (*Geniculograptus*) *typicalis posterus* Ruedemann, *Orthograptus quadrimucronatus* (Hall), *Rectograptus amplexicaulis* (Hall), *Leptograptus flaccidus* (Hall), and other species. At Whitby and at Little Current, Manitoulin Island – where the Whitby Formation disconformably overlies the Trenton Group – the lower member is followed by the upper grey shale member yielding graptolites of the succeeding *Paraclimacograptus manitoulinensis* Zone, such as *P. manitoulinensis* (Caley), *Anticostia lorrainensis*

(Ruedemann), *R. amplexicaulis*, *Pseudoclimacograptus clevensis* Skoglund, *Orthograptus eucharis* (Hall) and *O. quadrimucronatus*. (See also Ludvigsen and Tuffnell, 1994, p. 186).

Similarly, in the Lake St. John area on the Precambrian Shield in south-central Quebec, the hard, micaceous, dark-grey-greenish Macasty Shale (renamed the Pointe-Bleue Shales by Desbiens and Lespérance, 1989) lying disconformably on the Trenton Limestone, yields graptolites of the uppermost *C. pygmaeus* Zone, with *C. typicalis magnificus*, *L. flaccidus*, *Orthograptus eucharis* (Hall) and *C. pygmaeus* as the most common species. This fauna extends through about 5 m of compacted, dark brown shale and it is succeeded by *P. manitoulinensis*, *P. clevensis* and other species of the *P. manitoulinensis* Zone, but without undergoing a change of lithology as in the Whitby Formation at Whitby, Ontario (Riva, 1969, p. 542–543).

CONCLUSIONS

The dark brown shales of the Whitby Formation and the Pointe-Bleue Shales mark the onset of the final transgression of Iapetus Ocean on the Laurentian Shield after the emplacement of the Taconic allochthon in late *Climacograptus spiniferus* Zone time. As this transgression began almost two chronozones after the deposition of the basal shale of the Amadjuak Formation, one is led to conclude that the arm of the Iapetus Ocean, which reached Baffin Island (and probably Akpatok Island) in early *Climacograptus spiniferus* Zone time, did not come across the Laurentian Shield from the southern hemisphere at the onset of the Taconic Orogeny, but followed a more easterly route.

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LATE MIDDLE–EARLY LATE ORDOVICIAN CHITINOZOANS FROM THE BASE OF THE AMADJUAK FORMATION, SOUTHERN BAFFIN ISLAND, NUNAVUT

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Late Middle–early Late Ordovician chitinozoans from the base of the Amadjuak Formation, southern Baffin Island, Nunavut; in Geology and paleontology of the southeast Arctic Platform and southern Baffin Island, Nunavut; Geological Survey of Canada, Bulletin 557, p. 241–245.

Abstract

A chitinozoan microfauna from one sample in the lower Amadjuak Formation in southern Baffin Island has yielded *Acanthochitina cancellata* Martin, *Belonechitina kjellstromi* (Martin), *Belonechitina* cf. *capitata* (Eisenack), *Sphaerochitina gracqui* Martin, and *Sphaerochitina* sp. This microfauna is correlated with the chitinozoan *Acanthochitina cancellata* Zone of Eastern Canada, suggesting a biostratigraphic position at the Shermanian–Edenian transition for the lower Amadjuak Formation.

Résumé

Une microfaune de chitinozoaires d'un échantillon prélevé dans la partie basale de la Formation de Amadjuak dans le sud de l'Île de Baffin a livré *Acanthochitina cancellata* Martin, *Belonechitina kjellstromi* (Martin), *Belonechitina* cf. *capitata* (Eisenack), *Sphaerochitina gracqui* Martin, et *Sphaerochitina* sp. Cette microfaune est mise en relation avec la Zone à chitinozoaires à *Acanthochitina cancellata* de l' Est canadien suggérant une position biostratigraphique à la transition du Shermanien–Edenien pour la partie basale de la Formation de Amadjuak.

INTRODUCTION

Chitinozoans, a group of extinct, marine, organic-walled microfossils, have been the subject of biostratigraphic studies in Ordovician rocks of Eastern Canada since the 1970s. These studies have led to a chitinozoan zonation being established, which has proven of value in making biostratigraphic correlations of Ordovician successions in northern Canada (Achab and Asselin, 1995).

The lower part of the Ordovician Amadjuak Formation of the Jordan River outlier in southern Baffin Island (section 11A of McCracken, this volume) consists of dark brown, micaceous shale that yields numerous, long-ranging shelly fossils (Bolton, this volume), conodonts of late Shermanian–early Maysvillian age (McCracken, this volume), graptolites of the lower *Climacograptus spiniferus* Zone (Riva, this volume) and diagnostic chitinozoans. These last two groups of fossils date more precisely the basal part of the formation.

CHITINOZOANS AND CORRELATION

Chitinozoans were extracted from one sample (GSC loc. O-104538) collected 4.5 m above the base of the Amadjuak Formation. The microfauna contains *Acanthochitina cancellata* Martin 1983, *Belonechitina kjellstromi* (Martin 1975), *Belonechitina* cf. *capitata* (Eisenack 1962), *Sphaerochitina gracqui* Martin 1983 and *Sphaerochitina* sp. (see Plate 1).

This microfauna differs from those previously described by W.A.M. Jenkins (*in* MacLean et al., 1977) from core samples of the southeastern Baffin Island shelf (Drill stations 5, 8A and 8B), which were considered to be of Middle to Late Ordovician (Caradoc) age. None of the species listed by Jenkins were identified in the Amadjuak Formation.

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With the exception of *Belonechitina* cf. *capitata*, the components of the microfauna of the Amadjuak Formation are all known from chitinozoan associations of the St. Lawrence Lowlands of Quebec (Martin, 1983; Achab, 1987) at the Shermanian–Edenian transition (upper *O. ruedemanni* to *C. spiniferus* zone). In Eastern Canada, these associations are characterized by the first appearance of *Acanthochitina cancellata*. This species defines the *A. cancellata* Zone at the Shermanian–Edenian transition (Achab, 1989). *Acanthochitina cancellata* is characteristic of microfauna C5 observed at the top of the Neuville Formation and the base of the Lotbinière Formation at Portneuf, Quebec, and in the Grondines member of the Neuville Formation of the Quebec City area (Martin, 1983). The species has also been observed in Trenton and Utica levels yielding graptolites of the *O. ruedemanni* and/or the *C. spiniferus* zones in the Bald Mountain Saint-Roch no. 1 core, near Sorel, Quebec (Achab, 1987); in levels assigned to the *C. spiniferus* Zone in the lower Utica (1550'; 472.4 m level) of the Lozo-Joseph no. 2 core in the Saint-Jean Iberville area, southeast of Montreal; and in the Macasty Shale (3256'; 992.4 m level, LGPL core) of Anticosti Island (Achab, 1987). Similar chitinozoan associations containing *A. cancellata* were also extracted from "Trenton" strata in the Soquip Laduboro no. 1 core (4050'; 1234.4 m level) at Nicolet and in the Husky Gentilly no. 1 core (5100' and 5300'; 1554.4 m and 1615.4 m levels) of the Bécancour area (Achab, 1987; pers. observation). Biostratigraphic control from other fossils, however, is not available in these cores. Nonetheless, the similarities of chitinozoan associations suggest a correlation with the *A. cancellata* Zone for all these levels.

Acanthochitina cancellata also occurs in chitinozoan microfaunas of the St. Lawrence Lowlands derived from levels assigned to the succeeding lower *C. pygmaeus* Zone (pers. observation). However, these microfaunas differ from those at the Shermanian–Edenian transition by the presence of *Conochitina pygmaea* Achab 1987, *Spinachitina bulmani* (Jansonius 1964) and *Ancyrochitina merga* Jenkins 1970. In a previous paper, Achab (1987) noted the presence of *A. cancellata* in the 100–600' (30.4–182.8 m) interval of the Lozo-Joseph no. 2 core. This upper Utica level has yielded graptolites of the *C. pygmaeus* Zone (Riva, 1969), and it is probably older than that of the Bald Mountain Saint-Roch no. 1 core (1404-1950'; 427.9-594.3 m interval) where chitinozoan associations contain *C. pygmaea* but not *A. cancellata* (Achab, 1987). Achab (1987) also recognized *A. cancellata* from the 3190' (972.3 m) level of the Macasty Shale in the LGPL core of Anticosti Island. A recent restudy of the Anticosti material has also led to the identification of this species at the 3160' (963.1 m) and 3180' (969.2 m) levels. These levels in the Macasty Shale belong to the *C. pygmaeus* Zone (3160'; 963.1 m) or to the *C. spiniferus* and the *C. pygmaeus* zones transitional interval (3180' and 3190'; 969.2 m and 972.3 m) (Riva, 1969). All these Edenian chitinozoan microfaunas can also be distinguished from those at the Shermanian–Edenian transition by the presence of *C. pygmaea* and *Pterochitina hymenelytrum* Jenkins 1969.

CONCLUSIONS

Based on the presence of *A. cancellata* and the absence of *C. pygmaea*, *S. bulmani*, *A. merga* and *P. hymenelytrum*, the chitinozoan microfauna from the lower part of the Amadjuak Formation is correlated with the *A. cancellata* Zone of the Shermanian–Edenian transition (upper *O. ruedemanni* to *C. spiniferus* zone) of Eastern Canada (Achab, 1989). Its occurrence supports the lower *C. spiniferus* Zone age assignment suggested by Riva (this volume) for the lower Amadjuak Formation on the basis of graptolites.

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PLATE 1

All specimens are from the Amadjuak Formation at the Jordan River outlier, Baffin Island (GSC loc. O-104538). All illustrated specimens are hypotypes unless otherwise indicated, assigned Geological Survey of Canada type numbers (GSC 117670 to GSC 117678) and housed in the National Type Collection of Invertebrate and Plant Fossils at the Geological Survey of Canada, 601 Booth Street, Ottawa, Ontario K1A 0E8.

Figures 1–3. *Belonechitina kjellstromi* (Martin 1975)

1. GSC 117670 (x250)
2. GSC 117671 (x250)
3. GSC 117672 (x250)

Figures 4–7. *Acanthochitina cancellata* Martin 1983

4, 5. GSC 117673 (x400); detail of ornamentation (x800)

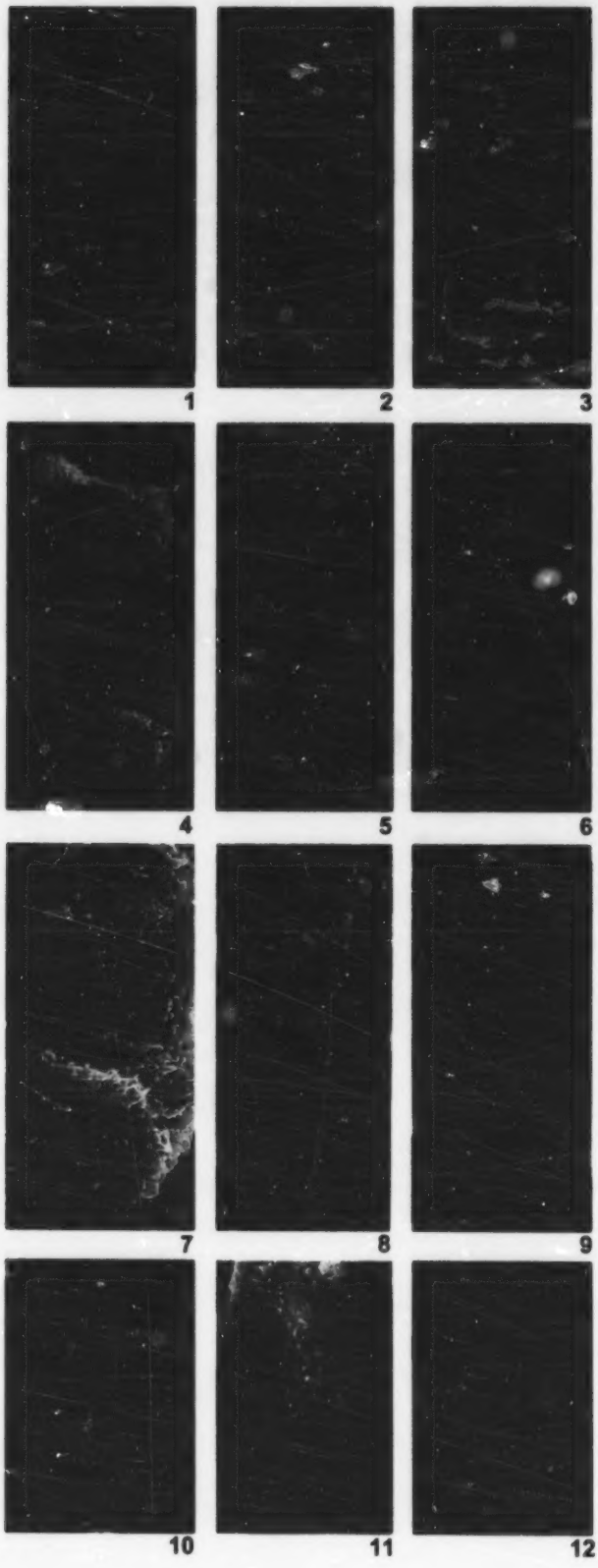
6. GSC 117674 (x250)
7. GSC 117675 (x1800)

Figures 8, 9. *Belonechitina* cf. *capitata* (Eisenack 1962). Figured specimen, GSC 117676 (x250), detail of ornamentation (x750)

Figures 10, 11. *Sphaerochitina* sp. Figured specimen, GSC 117677 (x250), detail of tubercules (x1800)

Figure 12. *Sphaerochitina gracqui* Martin 1983. GSC 117678 (x250)

Plate 1



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